BATTERY AD-X2

HEARINGS

BEFORE THE

SELECT COMMITTEE ON SMALL BUSINESS

UNITED STATES SENATE

EIGHTY-THIRD CONGRESS

FIRST SESSION

ON

INVESTIGATION OF BATTERY ADDITIVE AD-X2

MARCH 31, JUNE 22, 23, 24, 25, AND 26, 1953

Printed for the use of the Select Committee on Small Business

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BATTERY AD-X2

TUESDAY, MARCH 31, 1953

UNITED STATES SENATE,
SELECT COMMITTEE ON SMALL BUSINESS,
Washington, D. C.

The committee met, pursuant to notice, at 2:05 p. m., in room 457, Senate Office Building, Senator Edward J. Thye (chairman) presiding.

Present: Senators Thye (chairman), Ferguson, Saltonstall, Hendrickson, Duff, Sparkman, and Hunt.

Also present: Blake O'Connor, professional staff member, and William D. Amis, investigator.

The CHAIRMAN. If the committee will come to order, we will proceed.

Ladies and gentlemen, there is one thought that I, as chairman, have, and that is to help create an atmosphere in our general economy that is conducive to the welfare of small-business enterprise and the creation of new business. That is one of the objectives of this committee. For that reason we are delighted that we have the opportunity to have the Secretary of Commerce, Mr. Sinclair Weeks, with us this afternoon.

Mr. Weeks, you may proceed in whatever manner you desire.

STATEMENT OF SINCLAIR WEEKS, SECRETARY OF COMMERCE, ACCOMPANIED BY CRAIG R. SHEAFFER, ASSISTANT SECRETARY OF COMMERCE FOR DOMESTIC AFFAIRS, AND HAROLD B. CORWIN, DEPUTY GENERAL COUNSEL, DEPARTMENT OF COMMERCE

Secretary WEEKS. Mr. Chairman, I have a statement which I should like to read concerning the so-called battery additive AD–X2, which has been under discussion in the Commerce Department.

Even before I came to Washington my mail in Boston was heavy with letters from people telling me that an outfit in Oakland, Calif., making a product called AD–X2 to prolong battery life through reducing sulfation, was having tough sledding in Washington. Your committee, in fact, issued a report on the subject last December. One of the first things I did was to ask Mr. Sheaffer, Assistant Secretary for Domestic Affairs, to make a full and impartial investigation. He and his men have gone through file after file extending over the past 5 years.

Exhaustive examination of the files shows:

1. When this manufacturer put his product on the market in 1948 he was confronted with a pamphlet prepared by the National Bureau of Standards—No. 302—condemning all battery additives. This pam-

phlet was obtainable from the Bureau of Standards for the asking by anyone interested in combating the sale of the new product.

2. When he asked for tests to prove the merit of his product the National Bureau of Standards resisted making further tests, stating that basically the product was the same as others previously tested. The manufacturer, under these circumstances, could only tell his customers that his product had not been tested by the National Bureau of Standards and, therefore, Pamphlet 302 did not apply to it.

3. The files show that scientists in the National Bureau of Standards were in touch with and worked closely with individuals and organizations who might have had an interest in the final outcome, submitting their work to them previous to publication and seeking their advice and guidance. In response to the National Better Business Bureau's request that Circular 302 be strengthened to "combat the flood of battery dopes" came a statement from Dr. Condon, then head of the National Bureau of Standards, which was widely circulated. There also came in 1951 a new circular, No. 504, from the National Bureau of Standards to supersede No. 302. This was advertised through press releases by the Department of Commerce as being available at 15 cents from the Government Printing Office. It sold.

4. While the manufacturer was having no luck getting the National Bureau of Standards to run tests which would show that his product was different from previous additives tested and had merit, I find the National Bureau of Standards suggesting to the National Better Business Bureau that tests would be made if requested by the Federal Trade Commission. The Federal Trade Commission very promptly docketed the case—and the Post Office followed through later—although in all this period I can find no evidence of one single complaint by a user of the product. On the contrary, there are a great many testimonials from users stating that the product was saving them money by prolonging the life of their batteries. Many of these statements were made by reputable firms operating trucks, buses, and tractors, as well as industrial equipment depending on batteries. I further find that the Oakland Better Business Bureau circulated their findings of no complaints as to product, personnel, or methods of doing business.

5. The manufacturer claims that, to this date, he has not been able to get the National Bureau of Standards to run a test that would show the merit of his product. A test was agreed upon, but 10 modifications in the procedure were made by the National Bureau of Standards.

6. The manufacturer had independent tests made by the United States Testing Co. of Hoboken, N. J.—controlled field tests extending over a period of 362 days. These tests rendered credible the experience reported by consumers.

7. Your committee enlisted the aid of the Massachusetts Institute of Technology whose findings differed in some respects from the National Bureau of Standards' findings, even if, as some claim—including MIT—they cannot be interpreted as being so broadly favorable to AD–X2 as was done in the report of your committee dated December 18, 1952. However, Dr. Weber of MIT states that extensive tests might show the value of the product. Presumably, this statement put believability into the United States Testing Co.'s report.

8. The present status of the matter is that there is a suspended fraud order against Pioneers, Inc., Mr. Ritchie, his wife, and Mr. Hager,

vice president of the firm, in the Post Office Department. After issuance on February 24, 1953, it was suspended by Postmaster General Summerfield at my request in order that I might investigate further. There is also an open docket in the Federal Trade Commission.

Throughout this whole matter runs the fact that the National Bureau of Standards is the keystone on which other agencies of the Government depend. The Post Office calls it their supreme court on questions of fraud in a case like this. The Federal Trade Commission relies on its tests in a similar manner.

The Bureau, which is supposed neither to approve nor condemn a product, has, by its very setup, the power to make the introduction of a new product on the market very difficult, to prevent a product's being advertised by the Federal Trade Commission action, and to have people labeled "fraud" and denied the use of the mails. If this power is objectively and correctly used, it has great value to all the people of this Nation. However, if the Bureau's foot slips, a business starting in against all the normal competitive hazards, finds itself up against something with which it cannot cope, the vast power of the United States Government. Unless the small-business man knows a very great deal about Government, or has the finances to employ experts, he is obliged to quit.

I cannot bring myself to believe that the people making AD–X2 have the intent to defraud—and without intent, I do not see how there can be fraud.

I know that this business has suffered severely at the hands of certain bureaucrats. In fact, it is a wonder they are in existence at all after 5 years of struggle. Your committee might want to reexamine the legislation giving the Federal Trade Commission very broad powers in matters like this.

I am not a man of science, and I do not wish to enter into a technical discussion or be accused of overruling the findings of any laboratory. But as a practical man, I think that the National Bureau of Standards has not been sufficiently objective, because they discount entirely the play of the market place and have placed themselves in a vulnerable position by discussing the nature and scope of their prospective reports with the very people who might not want to see the additive remain on the market, and when their reports and results of tests were questioned, discussed the matter with other scientists, engaged by your committee to make separate, objective findings.

I cannot help but wonder how many similar cases have never been heard about—how many entrepreneurs who were convinced they have a good thing for the people, were licked before they started, whether they knew it or not and by their very own Government to whom they paid high taxes.

It can generally be said that there are no complaints but, on the contrary, many testimonials to the fact that the product is good and has saved the users money. As a practical man, I do not see why a product should be denied an opportunity in the market place. I believe that the purpose of the Congress in establishing the Bureau of Standards and in giving powers to such agencies as the Federal Trade Commission and the Post Office Department to act to prevent unfair practices and the perpetration of frauds, was that they should be operated or their powers should be exercised in the interest of the general public

and that such interest should be substantial and specifically and positively shown to be adversely affected before the power is used.

At this point, Pioneers, Inc., has a long way to go. It has to make its peace with the Post Office Department. It has to get off the hook with the Federal Trade Commission. It has to fight its way back in to customers it has lost, including the Government. It probably has to get financing to replace the funds lost through fighting the Government so far.

Because I feel that the Commerce Department's skirts are not entirely clean, and because I think we may have been the cause of prejudicial action against Pioneers by the Federal Trade Commission and the Post Office, and because our job at Commerce is to operate for the general public interest and to help business in every possible manner, I propose to:

1. Get the best brains I can find to examine into the functions and objectives of the Bureau of Standards and reevaluate them in relation to the American business community and other agencies of Government. This is a job that we should do, and I guarantee it will be done, and your committee will always be thoroughly posted as to the actions we are taking;

2. As quickly as I can find the money in the budget, I am going to put a group of scientists in the Bureau who have never had any connection with this matter and tell them to test this thing in every conceivable way—even to the extent of field tests in actual operations; and

3. I am going to direct the withdrawal of Circular 504 and all other circulars and technical reports dealing with battery additives until such time as those tests are completed.

Finally, a personal word which may be to the point: This particular battery additive, I found after I got into this thing—I had never known about it before, but the company with which I was formerly associated had a battery for which they had paid approximately $1,300. The battery was about licked. It was not functioning properly.

The CHAIRMAN. If I may interrupt at that point, there is no question but that you can test a battery as to whether the life of the battery plates are practically used up or exhausted. I am not a battery expert, but I do know they have a scientific test whereby they can determine that a battery is practically used up, the plates are so exhausted that a recharge of the battery would not be possible. Therefore, if the battery were practically used up, your experts would have known it; isn't that true?

Secretary WEEKS. In our case we apparently did know it. We knew the battery was used up. We had gone out and bought a new battery for $1,300 when these battery AD–X2 people came along. We took it on a when-as-and-if issue basis, tried it out. It worked. The last report I had after at least 13 months, I believe, was that the new battery is still standing in the corner and has never been used. That is a modest personal experience that we had with this very thing we are discussing.

The CHAIRMAN. In other words, the life of the old battery was extended by more than 13 months? That is your testimony?

Secretary WEEKS. That is right.

The CHAIRMAN. And still is working?

Secretary Weeks, the question that concerns me is this: The Bureau of Standards had not run a scientific test on this product when they condemned it. That was your testimony. In other words, they condemned a product without officially testing it. They said it was just another of the so-called additives which have proven to be of no use or value in the life of a battery so they condemned it, as I understood your testimony, before ever having run a test on this product.

Secretary WEEKS. I would like to have Mr. Sheaffer answer that.

Mr. SHEAFFER. Before the tests were acceptable to the manufacturer. The tests as prescribed by the manufacturer, the manufacturer claims were not followed. They departed from those tests in 10 important points and have not followed the tests which would show that the product was superior. We cannot say that the scientific tests were good or bad. We say that the manufacturer shows in his testimony, in his findings, that they have not at any time followed the tests that he says will show the superiority of his product.

The CHAIRMAN. Senator Saltonstall, do you have some questions?

Senator SALTONSTALL. I would like to ask one question. I read about this in the newspaper column this morning for the first time. Mr. Sheaffer, that story, as I read it, disagreed with the testimony Secretary Weeks gave here, did it not, the story that appeared in the Washington Post this morning?

Mr. SHEAFFER. I read that rather hurriedly. We disagree on a number of points. I wouldn't be in a position to make a statement as to exactly where the disagreement is, but certainly a basic fundamental difference in this morning's newspaper statement and our findings with respect to this product is apparent.

Senator SALTONSTALL. In other words, you felt strongly enough to ask a member of the Bureau of Standards to resign, to retire. In other words, was there any wrongdoing in this, or just poor judgment?

Secretary WEEKS. We have felt rather strongly about this particular situation. It is one of many phases of that particular picture that caused us to decide that it would be well to have a change in the administration of the department.

Senator SALTONSTALL. Thank you, sir.

The CHAIRMAN. Any further questions?

Senator SALTONSTALL. No.

The CHAIRMAN. Senator Hunt.

Senator HUNT. Have you talked personally with the men in the Bureau of Standards who conducted the tests on the additive?

Secretary WEEKS. I have not; no.

Senator HUNT. Was the circular signed personally by Dr. Condon? Do you know that Dr. Condon had anything more to do with it than just the ordinary routine way that circulars pass across one's desk and get printed?

Mr. SHEAFFER. I should say only that it is customary when a circular goes out from the Bureau—in our short stay there—we have found that the head of the Bureau, Dr. Astin, was aware of these circulars, had a great deal of knowledge of them. I would assume that Dr. Condon was in the same position and that he did know about them.

Senator HUNT. You gentlemen both know, I am sure, that down through the years the Bureau of Standards has been looked upon by

the people of the United States as the last word in accuracy and honesty and things of that type. You are aware of that, I am sure.

Mr. SHEAFFER. Certainly I am aware of that. We hope that it maintains that reputation.

Senator HUNT. Don't you think it is going a little far to discharge a man like Dr. Condon over an incident of this type?

Mr. SHEAFFER. It is Dr. Astin.

Senator HUNT. I thought it was Dr. Condon.

Secretary WEEKS. Dr. Condon retired several years ago.

Senator HUNT. Regardless of who the personality may be, I think that it is getting a little tough to ask the man to get out because of one mistake. He may have done a million things that were right.

Mr. SHEAFFER. This is not the only reason that Dr. Astin is resigning. This is one factor in a number of reasons.

Senator HUNT. I think you should give the committee the rest of the reasons.

Mr. SHEAFFER. We are not prepared to do so right now, sir.

The CHAIRMAN. Senator Hunt, any further questions?

Senator HUNT. Nothing further.

The CHAIRMAN. Senator Duff?

Senator DUFF. Mr. Weeks, as I summarize what you have had to say, it is, No. 1, that the National Bureau of Standards has not made the kind of test that the manufacturer said was necessary in order to determine its value. That is the first item.

Secretary WEEKS. That is right.

Senator DUFF. No. 2, that they had completely disregarded practical experience of those who did use this additive.

Secretary WEEKS. I would say so, sir.

Senator DUFF. No. 3, that a fraud bulletin was put out against it despite the fact that the Bureau had not properly tested the product and the fraud bulletin refused the mails to the manufacturers of the product, and as a result of it they were put under a very serious handicap in manufacturing it.

Secretary WEEKS. That is correct.

The CHAIRMAN. Senator Hendrickson.

Senator HENDRICKSON. I have no questions, Mr. Chairman, thank you.

The CHAIRMAN. Mr. Secretary, you have given us a very enlightening statement from the standpoint of what you have found to be in the records of the Commerce Department relating to AD–X2. I have looked over the report as submitted by MIT in its test on AD–X2. Certainly that great institution would not put out a report unless they had made an extensive study of it. Unfortunately, if the Bureau of Standards did not go in and make an extensive test of this product before condemning it, it certainly was destructive for a Federal bureau to take that position against a new business being created. That relates to what I had in mind when I said it is our responsibility in the Committee on Small Business to endeavor to develop an atmosphere that would be conducive to the creation of a new business or the healthy life of a small business activity. Your testimony has been helpful to me at least to this extent, that I have learned that the Bureau of Standards, one great Federal agency, had failed to make an extensive test of the product before they condemned it and before they reported to the Postmaster General that the product

should be labeled as a fraud and the company denied the use of the mails. I thank you as a member of this committee for the testimony that you have given us.

Senator Sparkman, former chairman of this committee, has come in. Senator Sparkman, we are glad you arrived. We have just about used up all the questions that the committee felt they wanted to ask of Mr. Weeks on this matter.

Senator SPARKMAN. I apologize for being late, but I attended another committee meeting. I was not here when Mr. Weeks made his statement; therefore, I have no basis upon which to ask him any questions. I had the privilege of asking Mr. Weeks questions this morning on a different subject, but one in which we have a great deal of interest.

Secretary Weeks. A first cousin to this subject, sir.

Senator SPARKMAN. That is right.

The CHAIRMAN. Do you wish to ask the Secretary some questions about AD–X2?

Senator SPARKMAN. I was not here when the statement was made. I didn't hear it.

The CHAIRMAN. Senator Ferguson is here, too.

Senator FERGUSON. I will read the Secretary's statement. I have no questions.

Senator SALTONSTALL. I would like to ask Secretary Weeks this question. The Bureau of Standards is in your Department, is it not?

Secretary WEEKS. That is correct.

Senator SALTONSTALL. Does the Director of the Bureau of Standards, the present head, disagree with this statement of yours? Does the Bureau deny the accuracy of your statement? Where do we go? You made the statement as Secretary, as head of this Department, which, in substance, challenges the work of the division. Is there anybody who disputes your statement? Is there anybody who disagrees with you in the Bureau of Standards, with what you have said?

Secretary WEEKS. That particular question I would like to ask Mr. Sheaffer to answer. In a general way the Bureau of Standards is, I think, my responsibility as long as I hold the office I have. The present head has submitted his resignation. In this particular case I think the subject company has not been given fair treatment and I hope to organize the Department, the Bureau of Standards and the Department generally, so that little businesses like this can get a fair break, and that is all I am interested in. I would say that it is my responsibility to decide what should be done in the Department, and this is the action that we have taken so far.

Senator SALTONSTALL. You believe that in this instance your Department is at fault, made an erroneous judgment?

Secretary WEEKS. I do.

The CHAIRMAN. Senator Ferguson.

Senator FERGUSON. I think that statement clearly indicates what the Secretary has in mind. At least small business and all business is going to have its day in court and be treated fairly by the administration. If there is an error, they are going to be willing to confess an error and correct it as soon as possible.

Secretary WEEKS. That is what I like to think we are going to do if it is necessary to do.

Senator FERGUSON. I take that statement as indicating it.

The CHAIRMAN. Senator Sparkman, have you had an opportunity to look over this statement sufficiently to wish to ask a question or not?

Senator SPARKMAN. No, Mr. Chairman. I assume that the committee has pretty well gone into it.

The CHAIRMAN. That completes the hearing. The hearing stands in recess.

(Whereupon, at 2:40 p. m., the committee adjourned.)

BATTERY AD-X2

MONDAY, JUNE 22, 1953

UNITED STATES SENATE,
SELECT COMMITTEE ON SMALL BUSINESS,
Washington, D. C.

The committee met, pursuant to notice, at 10 a. m., in the caucus room (318 Senate Office Building), Senator Edward J. Thye (chairman) presiding.

Present: Senators Thye (chairman), Ferguson, Saltonstall, Duff, Sparkman, Gillette, Humphrey, and Smathers.

Also present: Robert A. Forsythe, chief counsel; Blake O'Connor, professional staff member; and William D. Amis, investigator.

The CHAIRMAN. The committee will please come to order.

This is a full committee hearing of the Senate Select Committee on Small Business, called for the purpose of resuming the hearings which were commenced on March 31, 1953, and which recessed on the same day. This committee, in the course of its daily activities, meets and deals with many and varied problems faced by the small-business man in today's complex economy. Fortunately, most of the cases in the files of the committee have been settled and resolved very quietly and very effectively to the satisfaction of the contesting parties. Other cases present problems which take a longer time to solve. Still other cases command public hearings such as the one that we are holding here today.

In this particular case, this committee received a complaint from a small-business man who stated that the agencies of his Government were standing in the way of the sale of a product which he had invented. As you know, this man is Mr. Jess M. Ritchie, president of Pioneers, Inc., of Oakland, Calif. The product involved in this case is known as Battery AD–X2.

The issue which we are trying to resolve in the interest of the business, the Government, and the economy of our Nation can be simply stated. That issue is whether or not agencies of the Government have been fair and just in the treatment of Mr. Ritchie and his product, Battery AD–X2.

In approaching this case from the viewpoint of the small-business problem presented to us, we sincerely hope that a complete presentation of the facts as written into the public record during this hearing will assist the public, the agencies of the Government, and this committee to solve the issues as I have stated them.

It should be noted that at the present time there is a suspended fraud order against Mr. Ritchie and his company. This order, in fairness to all parties, should not be allowed to be held in abeyance indefinitely. Such an order, even though suspended, does damage to a

man's good name and to his company. We hope that through this hearing we may bring some light to bear on that phase of this case so that some firm determination may be forthcoming in the near future from the proper agencies involved.

Members of the committee, I believe it would be well that we have introduced into the record certain exhibits which have basic information concerning this case. These documents are:

The Keystone Batteries, Inc., letter, February 2, 1950.

(The letter referred to was marked "Exhibit No. 1" and appears in the appendix.)

The CHAIRMAN. The A. Brooks Berlin letter of April 16, 1953.

(The letter referred to was marked "Exhibit No. 2" and will be found in the files of the committee.)

The CHAIRMAN. Letter Circular 302 of the National Bureau of Standards.

(The document referred to was marked "Exhibit No. 3" and appears in the appendix.)

The CHAIRMAN. Circular 504 of the National Bureau of Standards.

(The document referred to was marked "Exhibit No. 4" and appears in the appendix.)

The CHAIRMAN. TRG–6116 of the National Bureau of Standards.

(The document referred to was marked "Exhibit No. 5" and appears in the appendix.)

The CHAIRMAN. The Technical Report 1537 of the National Bureau of Standards.

(The document referred to was marked "Exhibit No. 6" and appears in the appendix.)

The CHAIRMAN. Memorandum on Battery Additives by the National Bureau of Standards.

(The document referred to was marked "Exhibit No. 7" and appears in the appendix.)

The CHAIRMAN. Circular on Battery Compounds and Solutions, by the National Better Business Bureau, Inc.

(The document referred to was marked "Exhibit No. 8" and appears in the appendix.)

The CHAIRMAN. Test by the National Bureau of Standards, dated September 5, 1952.

(The document referred to was marked "Exhibit No. 9" and appears in the appendix.)

The CHAIRMAN. Report of the Massachusetts Institute of Technology.

(The document referred to was marked "Exhibit No. 10" and appears in the appendix.)

The CHAIRMAN. The tests by the Bureau of Ordnance.

(The document referred to was marked "Exhibit No. 11" and appears in the appendix.)

The CHAIRMAN. The test by the New York naval shipyard on AD–X2.

(The document referred to was marked "Exhibit No. 12" and appears in the appendix.)

The CHAIRMAN. The Signal Corps test of AD–X2.

(The document referred to was marked "Exhibit No. 13" and appears in the appendix.)

The CHAIRMAN. The Air Force test of AD–X2.

(The document referred to was marked "Exhibit No. 14" and appears in the appendix.)

The CHAIRMAN. Affidavits of users of AD–X2.

(The affidavits referred to were marked "Exhibit No. 15" and appear in the appendix.)

The CHAIRMAN. Members of the committee, these documents need not necessarily be printed in the report, but they should be made a part of the printed record or the committee files so that all who are interested in this hearing may read them and see how this case developed over the period of the many past months.

The first witness we will hear is Mr. Ritchie.

Mr. Ritchie, do you swear that the testimony you are about to give pertaining to the matter now before this committee is the truth, the whole truth, and nothing but the truth, so help you God?

Mr. RITCHIE. I do.

The CHAIRMAN. Mr. Ritchie, you may proceed.

Mr. RITCHIE. Thank you, Senator Thye.

TESTIMONY OF JESS M. RITCHIE, PRESIDENT, PIONEERS, INC., OAKLAND, CALIF.

Mr. RITCHIE. We are going to be using some terminology here that has to do with a lead-acid battery and which may or may not be familiar to the Senators. So, I would like to pull a cell of an ordinary battery and explain some of the nomenclature that will be used.

This is a cell out of what we call a cheater battery. It is a low plate put in a standard case. You could not tell that until you pulled it out of the case. There is no way of determining the size of a cell or its condition with any degree of accuracy without taking it out of the case. There are certain tests that we can make that will give an indication of the battery condition, but in order to determine the condition of a sample, it is necessary to pull and inspect visually and by feel, and even then we are never too sure, because there is very little known about the lead-acid storage battery.

This first plate here is a negative plate which is lead. After it is formed out through charging, we call it sponge lead. This plate here is hard and gritty. In other words, it is sulfated. When the plate is put on charge with the active material, which this lead is called in this hard condition, we pass energy between the grid and the active material causing this active material to flake off and fall to the bottom of the battery. This builds up and eventually touches across the bottom of the plates, shorts the battery out, and it becomes useless.

This is a separator that goes between this plate and the plate next to it, which is of a different material in that it is lead peroxide. Now, if this separator here has a small crack in it, a hole, or has become so mushy that it allows the lead to penetrate from one plate to the other one, then we have what we call a minute short.

We pull this plate off here, and we come to another separator, and this is grooved to allow the electrolyte to pass between the separator and the positive plate. Now, this positive plate is a different animal. This is lead peroxide, or lead dioxide, whichever one a person prefers to call it. When this material is hard, as it is in this case here, and we undertake to charge the battery, the material being inert, not being

able either to receive the current for conversion or pass the oxygen, that oxygen is used to convert the grid itself to active material.

Now, the grid in a battery is these cross wires that we see in here. We have about the same size in both plates. The time was when you made the negatives lighter and the positives heavier, but the mass-production method of today calls for making the plates approximately the same thickness.

Now, this lead in the grid, will always convert to this same peroxide that is necessary in the paste. It will always do that. When this active material becomes inert and will no longer function as it should, then the charge itself attacks these small grid bars. On overcharge, when you are charging current greater than can be passed here through these small wires, they become resistors and burn out.

Now, in this particular battery, there have been attempts made to charge the battery, and it has resulted in this plate here, even though it looks perfectly good, as you can see—the plate looks like it is in wonderful condition, and shows very little shedding—but we find that the plate has no grid in it. Those cross wires that went across there have been converted to peroxide. You could charge that plate with a real small current by treating it with our product. You could charge the plate with a real small current to the extent that this material itself would carry the current. But when you went to pull the energy out, you have nothing there to conduct the current out of the battery at high rate, with the result that, even though it appears to be a perfectly good element and in very good shape, the battery is useless.

Now, we have on the table a battery which has been on the shelf for 19 months. The battery was sold 2 weeks ago to a customer over in Arlington, and it was brought back here within a period of a week because it would not function.

Bear this in mind. The battery was pulled down. There was no "guesstimate" made on it. We did not guess that the plates are in this condition or the plates are in that condition. The battery was pulled apart, which is a very simple operation. It can be done with a hacksaw and a table knife in a matter of a few minutes.

The plates were inspected. It was determined that the battery was sulfated, and would not normally take or hold a charge. So instead of charging the battery and ruining it—we already know it is sulfated—we treated it, put it on the line Friday night, and this morning we have a battery here that has an open voltage of 6.20 volts, which is voltage for a healthy battery. We have a battery right here that, while dead Friday, we can take and pull 600 amperes on it, I hope. I haven't tried it. The man just set it up here. Batteries are vicious things. I wounded myself yesterday with one of them. Incidentally, these batteries put out about 22 horsepower, believe it or not.

Now, that battery was dead. It was worthless.

The CHAIRMAN. Who owned the battery, Mr. Ritchie?

Mr. RITCHIE. Campbell's Service at 5232 Wilson Boulevard, in Arlington, Va. It is 19 months shelf-aged, then sold and in service 1 week, returned for refund or a new battery, brought to the shop, pulled down on June 21, 1953, found to be hard, gritty and sulfated, treated with Battery AD–X2, on June 21, 1953, and then charged on slow charge at 5 amperes for 36 hours. Now, that battery has been——

Senator FERGUSON. Mr. Ritchie, you do not claim that your product charges the battery?

Mr. RITCHIE. No, sir.

Senator FERGUSON. It merely makes it so it will take a charge?

Mr. RITCHIE. That is true; yes, sir. It merely changes the electrolyte and lowers the resistance in the paste so that the battery can take a charge. Our product has nothing to do with charging the battery other than making it capable of taking a charge.

Senator SALTONSTALL. Mr. Chairman, may I ask who serviced the battery originally? Did you?

Mr. RITCHIE. No, sir.

Senator FERGUSON. Is the man here?

Mr. RITCHIE. No, sir.

Senator SALTONSTALL. So that battery came into your shop after it had been working only for a week and then died?

Mr. RITCHIE. Yes, sir. It is from one of my dealers' shops.

Senator SALTONSTALL. So that battery came from one of your dealers' shops in to you for either a refund, a new battery, or to be fixed up, and you fixed it up with your specialty?

Mr. RITCHIE. The way the manufacturer works, after this battery has been out for 90 days, they will not replace it. So it was a matter of the man spending $26 for a new battery or spending $3 for Battery AD–X2.

The CHAIRMAN. Mr. Ritchie, what I would like the record definitely to show is, why a dealer would leave a battery on his shelf for 18 months? Why would he leave a battery that long on his shelf? I thought that a dealer would normally try to move a battery in less than 90 days because of the fear that if the battery is out more than 90 days, he would have no recourse if anything occurred within the construction of the battery. I want the record to be clear as to what happened here. Why did the man have it in his place of business for 18 months?

Mr. RITCHIE. Senator, I have no way of answering that question. I can tell you what generally happens in those conditions. I bought a bunch of Lee batteries here in town not too long ago. It is not too easy to do, because the junk people are all bonded to break the batteries down and sell them. But I found, I believe it was, 16 Lee batteries in town that were about 3 years old. What happens is that the help in the shop when they bring the new batteries in, set them in front. So the help take the batteries from off the front, and the back batteries keep getting older and older.

Now, a cautious operator, of course, will (1) put his batteries on trickle charge. That is a little hard on the grid in the positive plate, but it keeps the battery fresh; (2) he will rotate-charge his batteries. In other words, when they bring new batteries, they put them in the back and put the old batteries in the front. That is what should happen. But we find cases where people overbuy. There was an outfit in Fresno a few years ago which bought three carloads and they let them sit until they were about a year and a half old, and I had the pleasure of buying them and treating and selling them.

What happened in this case, I do not know. I do not know how it was on the shelf for 19 months.

The CHAIRMAN. Senator Saltonstall, I interrupted you, for which I am sorry.

Senator SALTONSTALL. All I wanted to make sure of in my own mind, Senator Thye, is this: Mr. Ritchie, you did not originally service this battery; you did not originally sell this battery?

Mr. RITCHIE. No.

Senator SALTONSTALL. The battery was sold, was serviced, went dead, and then came in to one of your dealers' shops and came back to you?

Mr. RITCHIE. Yes, sir; at my request. This has to go back to the customer.

Senator SALTONSTALL. But it came to you at your request to see if your specialty would work on it?

Mr. RITCHIE. That is right.

Senator SALTONSTALL. And the specialty, in your opinion, has worked on it?

Mr. RITCHIE. Yes.

Senator SALTONSTALL. So that you are going to send this battery back to your dealer to be returned to the customer?

Mr. RITCHIE. Yes, sir. Now, if my dealer had attempted to charge that battery before he treated it, he would have ended up with the same condition we have here, with no grid in the positive plate. That is a condition that we are constantly working on, people taking batteries and trying to charge them, or taking a battery that is way over age and treating it.

Our recommendations are: That a mechanically sound battery be treated if 6 months old or less and in a composition case—that is a cheap battery—or if a year old or less in a hard-rubber case that has not been abnormally abused. Beyond that point, we do not recommend that people treat their batteries. We recommend that they take them into our shops and let us lift the cells out, check them, and then put them back together and treat them, if they will stand it.

Senator FERGUSON. You claim that you can tell whether or not they can be treated?

Mr. RITCHIE. By taking them in and lifting them up out of the case, we can.

Senator FERGUSON. Was this battery opened?

Mr. RITCHIE. Yes.

Senator FERGUSON. And you looked at it?

Mr. RITCHIE. I didn't. My serviceman did; yes, definitely. But it is 19 months old. We have no way of knowing whether the battery has been previously charged and the grid taken out of the positive plate or not.

Senator FERGUSON. How can you tell it is 19 months? Is it marked on the battery?

Mr. RITCHIE. Every battery has its history. It has its history stamped on the lead slugs here on the top.

The CHAIRMAN. You have acids in there, so it is difficult for you to turn the battery over.

Mr. RITCHIE. Yes, sir.

The CHAIRMAN. But if you look down upon that cross member that ties the negative and the positive risers, you would see figures stamped right in there?

Mr. RITCHIE. That is right.

The CHAIRMAN. I know that they have always done that, and I have examined them when I purchased batteries.

Mr. RITCHIE. Right; to see whether they are fresh or not.

The CHAIRMAN. Yes. Then those dates are stamped on there?

Mr. RITCHIE. Right.

The CHAIRMAN. That I know because we have quite a few batteries.

Mr. RITCHIE. We use these instruments, sun testers, here a great deal. All of our plants have them. If a battery comes in and we take it and run it up to 300 amps, we will say, and let it stand there around 5 volts, or around in there, we know that there is no short in the battery, because if you get any type of short in this cell here at all—for instance, if this piece of separator was lying across here and a few pieces of lead had caught on it to form a short circuit between the plates through the fluid itself, the battery is discharging in here instead of between the posts. So by running that type of check, we can tell whether a battery is shorted or not. If it won't hold its load, of course, then we pull it and check.

With your permission, gentlemen, I would like to take this chart over here and briefly run over this situation, and then I will take the files and start on the exhibits.

The CHAIRMAN. Mr. Ritchie, before you proceed to the chart over there, what do you claim that your compound does in order to prevent that short that you just demonstrated to us by showing this particle that had lodged across the bottom section of one of those cells?

Mr. RITCHIE. It wouldn't do anything, Senator. It is a chemical. It will not make any mechanical repairs. In other words, in the case of such a short as I showed you there, we would have to pull that battery and physically remove the short and put in a new separator. We could determine that short with this instrument here. In other words, when it would not hold its load with a certain specific gravity reading, then we would know that there was a short there. It might be that type of short or it might be that the separator is pinched or the plates might be bridged across the top. But the fact that the short is there would indicate that even though it was a new battery, we would have to pull it. In other words, that is an indicator.

The only way to remove a short is to do it physically.

Senator FERGUSON. Then you do not claim that this is a cure-all?

Mr. RITCHIE. No, Senator. The function of this material is very limited. It is very limited. This situation has come up repeatedly, that because we eliminate sulfation, which is a major cause of battery failure, it makes people feel that this is a cure-all, which actually it is not. All this material does——

Senator FERGUSON. Do you claim on the package that it is a cure-all?

Mr. RITCHIE. No, sir. We definitely say, "It lengthens the life expectancy of new batteries; it extends the life of mechanically sound sulfated batteries." And here we repeat that, and say, "Apply to mechanically sound batteries only." In other words, we don't recommend that it be applied to a battery that is not mechanically sound.

Senator FERGUSON. In other words, if there was a short or broken plate, you do not claim that this would cure it?

Mr. RITCHIE. That would have absolutely no effect upon it whatever, Senator.

The CHAIRMAN. Senator Gillette?

Senator GILLETTE. What claims do you make as to the length of extension of life?

Mr. RITCHIE. The only way you can tell what that is, is to put it in the field and find out. We have found, by close study of the cost records and by close study of past history of certain operations before and after using our product that we somewhat better than double the life expectancy of the battery. For instance, the average life of a battery in the United States is a little over a year, and still we have batteries that have been out for 5 years. Colonel Kehke, a man who used the material in Benecia, put it in a sulfated battery that would be in the same condition as that, in the latter part of 1947, and when he went to Germany recently, he told me he was going to have to change that battery. Of course, the battery was a junk battery in 1947, and he was still using it.

The CHAIRMAN. Mr. Ritchie, how does that compound work on that battery to extend the life of it?

Mr. RITCHIE. I don't know whether I can get this down to where it is plain enough or not. As I understand, in chemistry the purer a solution is that will crystallize, the more perfect the crystals; and the weaker the solution, the slower the growth of the crystals and the more perfect and larger they become. By adding foreign ions—for instance, in the case of a diamond, when impurities enter into the carbon, it is no longer a diamond. It becomes something else. It does not form out. When you discharge a battery, we find the acid combining with the lead in the negative plate and with the lead peroxide in the positive plate to form sulfate. Now, that sulfate has to be formed. A battery does not store any electrical energy. It simply stores the chemicals which, when they are brought together by an external contact, give you current.

So as you discharge the battery, your acid goes out of the water into the plates and forms this sulfate. Now, that sulfate, if it is readily recharged, converts right back again.

In theory, you should be able to do that indefinitely.

Senator FERGUSON. Do the scientists know really what makes a battery work?

Mr. RITCHIE. Senator Ferguson, I believe they do not. I believe it is an accident. We spent an awful lot of time and money on it. We have tested out a lot of good theories.

Senator FERGUSON. Could they have the same trouble, then, knowing what actually your compound does? Are there not certain chemical reactions that are pretty hard to explain?

Mr. RITCHIE. Frankly, Senator, I don't believe that anyone has ever explained to my satisfaction why the positive plate in a battery works at all. I have heard some very good men on it and some very capable scientists and some wonderful chemists on it, and those who actually know, or actually should know, let me say, are pretty much in agreement that it was an accident, and nobody knows too much about it.

Senator FERGUSON. In other words, they ran onto this thing of how a battery would work——

Mr. RITCHIE. Right.

Senator FERGUSON (continuing). By experiments, and not from a scientific basis, as it would work when it started?

Mr. RITCHIE. That is right. It was first discovered by a woman who happened to touch a piece of galvanized material with a knife and touched a frog leg. That is the way the thing worked out in France.

Senator FERGUSON. A frog's leg?

Mr. RITCHIE. Yes, sir; in France. They knew that the reaction between these two metals caused this quivering to be increased, and they got the idea across of the potential, which is called the potential now. In other words, lead has a potential of 2.1 volts per cell. Nickel cadmium has a potential of 1.2 volts per cell. Nickel iron has a potential of 1 volt per cell, and there is no——

Senator FERGUSON. You are going into a lot of terms with which, I am afraid, I, as a Member of the Senate, am not familiar.

Mr. RITCHIE. We will go back to our sulfation situation, then, Senator, if I may.

Senator FERGUSON. I did not want to get you into those technical terms.

Mr. RITCHIE. I am not too good with them, either, Senator Ferguson. But when we put this material in, then we add foreign ions, which cause these sulfate crystals to—instead of forming in a more perfect crystal on aging, they form in a lattice. In other words, they are crystals with cracks in them that are more susceptible to the charge than when they are in a more perfect crystal form. Now, it might be of interest to a lot of people, and to the Senators especially, to know how we run these tests.

What we have done, we have taken a bench and set it up to where we could get 56 10-ampere glass cells on the bench. Then we put a neon tube back of it and used a large magnifying glass in front, and we treat these cells with these various mixtures, always leaving one of the cells in the 4-volt battery untreated, where we would have something for comparison. When we had run 1,100 of these experiments, we found an additive that would work, but it lowered the hydrometer reading. You couldn't sell it. The average man checks the condition of that battery with a hydrometer. He takes it and puts it up here, and if it reads so much it is a healthy battery.

It lowered the hydrometer reading and we kept working on it. When we had a little over 1,600 experiments run, we ran into this additive. You will notice the mud in the bottom of this battery. Now we have known, the literature shows, and it has been generally accepted for years, that sodium sulfate, magnesium sulfate, or almost anything that will go into solution will help in the dissolving of this sulfation. So we have been working on various salts and various compounds, and we left this batch in process by accident, and when it came out it looked something like melted glass, and I wanted to throw it away. Well, Dr. Randall insisted on using it. So we used it.

Now, the thing that we were doing was marking these glass cells at the top of the mud. We knew that these materials helped in the solubility of lead sulfate. But what happened was that it poisoned the plate and the active material fell out. So by marking the top of the mud in each one of these batteries, all of which were badly sulfated, we could tell whether or not we were getting more shedding.

We put this substance in batteries and came back the next morning. Instead of having more shedding, we had less battery mud.

Senator FERGUSON. Do you claim that this was rather an accident that you fellows ran into this?

Mr. RITCHIE. It is a fact, Senator, that it was an accident.

Senator FERGUSON. Could it be that that is what makes it very difficult to explain?

Mr. RITCHIE. Yes; I rather think it does, because frankly we don't know why it works. We have a lot of theory, like many other people have, about lead-acid batteries. But the only thing that Dr. Randall could ever say was, "Well, it does it. Why, I don't know."

I have talked to a number of good people, good scientists, and they say the same thing. In other words, Dr. Randall ofttimes said, when we hit this and realized what we had done—we were talking about a patent—he said, "We should never get a patent."

Senator FERGUSON. This is not patented?

Mr. RITCHIE. This is not patented. It is a secret formula. It contains sodium sulfate and magnesium sulfate, but—and this is important—they do not appear as epsom and glauber salts. There are also 7 trace elements and a pH of 7.9, if that means anything to you, Senator.

Senator FERGUSON. It does not mean a thing to me.

The CHAIRMAN. That means absolutely nothing to me, sir.

Mr. RITCHIE. That is what the man said to me.

The CHAIRMAN. We interrupted you, Mr. Ritchie. You started to go to your chart, and I think that we had better let you proceed with your regular statement as you had organized it.

Mr. RITCHIE. Thank you, sir.

As some of you Senators know, I was having trouble with batteries in the Philippines. I came back to Oakland, Calif., with an idea of doing something about it. I am not a chemist; I am an engineer. I am basically a bulldozer operator. I have been in construction for a number of years, and I found out a long time ago that if you had a sheeting job, you got the best sheeting man you could get. If you had a pile-driving job, you got the best pile butt you could get. Always get the best you can, because anything less than the best is going to cost you. And when a construction man makes an error, he digs it up. When a draftsman makes an error, he rubs it out. So, in checking around to find out what could be done about these things, I ran into Dr. Merle Randall. Dr. Randall and Dr. G. N. Lewis wrote Thermodynamics and the Free Energy of Chemical Substances. He is internationally known for that work. He also wrote Elementary Physical Chemistry. I talked to a number of people at the University of California and Stanford Research Institute, and every one of them that I tried to get interested in the thing always said, "Get Merle Randall."

So, I got Merle Randall. All of our work was done under his direction, and we worked hard and diligently. We were trying to do something.

But, after we got this thing, Dr. Randall assured me that we had done it backward, that all of our reasoning and all of our work, from what he could determine on the product, had been a waste of time, for the simple reason that what we had done was illogical and could only have happened as an accident.

So, after we got the material developed and ran our own laboratory tests to the point that we had exhausted all we could find out in the laboratory, with Dr. Randall, Kenneth Bonnickson, and a number of other chemists on the thing, we went out and put the material in what we called controlled accounts. We went to large industrial accounts that had good cost-accounting records, and told them that we thought we had done something, and what we thought we could do for them.

Bear this in mind: Batteries were as scarce as hens' teeth; you couldn't get them in 1947.

So I got going, and while I was talking to a fellow one day, he said, "Have you seen Letter Circular 302?"

I said, "No; what is Letter Circular 302?"

"Well," he said, "something that was put out by the Bureau of Standards some years ago. A battery salesman was out yesterday and showed it to me."

I said Dr. Randall had mentioned that he had found it in the literature, but it was 1931, and I didn't pay too much attention to him.

I asked, "Could you get me a copy of it?"

He said he could.

In about 2 weeks, he shows up with that and Facts About Battery Dopes.

Now, Facts About Battery Dopes was a rehash of Letter Circular 302. It was statements by the Association of Battery Manufacturers, which said that they would void their guaranty if anything was added to the electrolyte. But that must have been put out prior to 1945.

Dr. Randall was concerned. I wasn't. We are talking about a document way back there in ancient history.

So we went ahead with the work, and they did become more numerous. When I first heard about them, they were a collectors' item.

Senator FERGUSON. You mean this document?

Mr. RITCHIE. Letter Circular 302, put out by the National Bureau of Standards, condemning all battery additives, and Facts About Battery Dopes put out by the National Better Business Bureau quoting the National Bureau of Standards and the battery manufacturers condemning all battery additives and stating that, if anything was added to the electrolyte of a lead-acid storage battery, the manufacturers would void their guaranty.

Senator FERGUSON. Was it not the National Bureau of Standards that put this 1931 document out?

Mr. RITCHIE. Right. That was put out by the National Bureau of Standards.

Senator FERGUSON. When?

Mr. RITCHIE. 1931.

Senator FERGUSON. 1931?

Mr. RITCHIE. 1931. The National Better Business Bureau rehashed it sometime prior to 1945. These things began to get pretty numerous. I was working in a community where I am fairly well known. I wasn't too much concerned about it. Our Better Business Bureau out there wrote to them, and Dr. Randall was concerned about it, but I still wasn't too much concerned. I was still working on a battery dope and seeing whether it works or not and to what extent.

Then in 1949, we are going along here up and down on sales, still experimenting. Everything is experimental up through here on application, cost records, and what have you. The material was never changed from there [indicating]. The material has been the same from right there. The name was changed because we lost the trademark to the Atlas Distributing Co.

Senator GILLETTE. Do the blue columns represent your sales?

Mr. RITCHIE. That is sales; yes, sir.

Senator HUMPHREY. What date did you say the material was not changed from?

Mr. RITCHIE. From October 1947.

Senator HUMPHREY. Is that when you had Dr. Randall working with you at that time?

Mr. RITCHIE. Yes, sir. Dr. Randall had been with me from back in here. And Dr. Randall was with me up until March 1950, when he passed away.

Then in 1949, the National Better Business Bureau came out with a brand new Battery Compounds and Solutions, which was nothing more than Letter Circular 302, and Facts About Battery Dopes, stating that all guaranties were voided if the battery was treated. In other words, they hadn't done anything about it. They just simply brought it up to date. That irritated me——

Senator FERGUSON. Had they tested your product, where you have that "1949"?

Mr. RITCHIE. No, sir. They had not tested it. They had not made any pretense of testing it. In fact, up to that time, I think they had never seen it, probably.

Senator FERGUSON. Was that 302 all-inclusive, all additives?

Mr. RITCHIE. All additives.

Senator FERGUSON. No matter what they were?

Mr. RITCHIE. No matter what they were. It says, "These compounds and solutions," and names a group of them which you could not mix very much of anything without using one of them, have no effect on the battery.

Senator HUMPHREY. May I ask a question? Did you change the formula along through this period?

Mr. RITCHIE. No, sir. The formula has not been changed since here [pointing to the chart].

Senator HUMPHREY. Since there?

Mr. RITCHIE. In other words, the formula back in here was an erratic situation which was a laboratory project. But from here, the material remained the same, and we changed the name over in here after we lost the trade-mark to the Atlas Distributing Co.

Senator HUMPHREY. Mr. Chairman, do you mind if I ask a couple of questions about that at this point?

The CHAIRMAN. No. You may ask the questions.

Senator HUMPHREY. The reason that I wanted to ask the questions is that Dr. Randall made some statements off and on during this period of time which I have checked into, which indicate some conflict of testimony, or possibly I do not have the full story. I would like to get it.

For example, in 1948, Dr. Randall wrote to the Bureau of Standards saying that the patent was originally the Keifer patent; is that correct?

Mr. RITCHIE. Well, the Keifer patent got into the situation in this way. When I came back from the islands, I had never heard about a battery dope in my life. I had never heard anything about it. And I ran into this fellow on East 14th Street and bought a half interest in the business. And what I bought there was a tremendous amount of trouble.

Senator HUMPHREY. Here is what Dr. Randall had to say in his letter to the Bureau of Standards:

One of my clients, Mr. Ritchie, purchased the equities—

as you pointed out—

in the patent application of Donald E. Keifer, covering Protecto-Charge, AD–X2's predecessor, an addition agent for storage batteries. Its composition is a mixture of anhydrous sodium sulfate, commonly known as glauber salt, and slightly basic, nearly anhydrous magnesium sulfate, epsom salt.

Mr. RITCHIE. You are quoting Dr. Randall?

Senator HUMPHREY. I surely am.

Mr. RITCHIE. And he said that: "epsom salt" and "glauber salt"?

Senator HUMPHREY. That is correct. That is what he said in his letter to the Bureau of Standards.

Mr. RITCHIE. Would you read a little further?

Senator HUMPHREY. The letter of April 23, 1948, from Mr. Randall to the National Bureau of Standards, and I quote from his letter, which says:

One of my clients, Mr. Ritchie, purchased the equities in the patent application of Donald E. Keifer, covering Protecto-Charge, AD–X2's predecessor, an addition agent for storage batteries. Its composition is a mixture of anhydrous sodium sulfate, commonly known as glauber salt, and slightly basic, nearly anhydrous magnesium sulfate, epsom salt.

Mr. RITCHIE. Senator, Dr. Randall never wrote "epsom salt" and "glauber salt" in any letter to anyone, I am sure.

Senator HUMPHREY. He wrote "anhydrous sodium sulfate" and "anhydrous magnesium sulfate." Anybody who has had the first year of college chemistry knows that one of those is glauber salt and one is epsom salt. One of them you give to horses and one to people; that is right, is it not?

Mr. RITCHIE. I am not a veterinarian.

Senator HUMPHREY. I have taken chemistry. I am a pharmacist. Now, I happen to know that you give glauber salt to animals and epsom salt to people. One is magnesium sulfate and one is sodium sulfate. Everybody knows that.

Mr. RITCHIE. I don't give them to people or horses, either one. The salts in this material do not appear as epsom salt or glauber salt.

Senator HUMPHREY. It is anhydrous sodium sulfate.

Mr. RITCHIE. Slightly basic.

Senator HUMPHREY. That means that it has slight traces of impurities.

Mr. RITCHIE. That is the key to the thing.

Senator HUMPHREY. It has slight traces of impurities which, under any chemical assay test simply means that this is low-grade epsom salt or low-grade glauber salt. That is all it means. The difference between anhydrous salt and a pure salt is the fact that there are still impurities in it. One is cheaper than the other; is that not correct?

Mr. RITCHIE. I believe that is right.

Senator HUMPHREY. Yes; that is very right.

Mr. RITCHIE. I believe that is right.

Senator HUMPHREY. If you go into the pharmacopoeia, or if you go into any one of these chemical journals, you will find the difference between a salt that assays out about 99.98, which is a pure salt, and an anhydrous salt, which has some basic materials in it, generally nothing more or less than just inert chemical properties.

Mr. RITCHIE. Senator, we know this. In our work, if you take epsom salt and glauber salt and put them in a battery, they assist tremendously in the solubility of lead sulfate.

Senator HUMPHREY. Yes.

Mr. RITCHIE. You get a coating around the grid of the negative plate, in the negative plate, and it seems to be an insulation there, and it causes the active material to fall out of the plate. Now, these impurities, these trace elements that are in battery AD–X2——

Senator HUMPHREY. What do you mean by "trace elements" that are supposed to have some peculiarities of bringing back electrical or new powers to a battery? What are these trace elements?

Mr. RITCHIE. These materials apparently—I am not a chemist, you realize that——

Senator HUMPHREY. Look. Any good chemical laboratory can make an assay test and can make a complete chemical analysis of all the properties that are in any solution or any mixture that you make. Now, what are these trace elements? That is not a mystical term. What are they?

Mr. RITCHIE. There are a number of things. There is silver, some that are added——

Senator HUMPHREY. Do you have a list of the trace elements?

Mr. RITCHIE. I think so. I don't know whether I have it with me or not.

Senator HUMPHREY. I suggest that we get a list of those trace elements.

Mr. RITCHIE. I would rather not disclose them, Senator, because I believe that no man has a right to give away a secret formula.

Senator HUMPHREY. Did the Bureau of Standards ever make any analysis of those so-called trace elements?

Mr. RITCHIE. They did. At the post-office hearing, I think they actually showed them for the first time.

Senator HUMPHREY. Did they ever tell you that they had any particular property or properties which in any way would increase the lasting qualities of a battery or increase its life?

Mr. RITCHIE. No, they have never done that.

Senator HUMPHREY. Surely a competent scientist or chemist would know what would be the effect of these alleged trace elements upon battery plates and battery acids and upon all the composition that goes into making a battery.

Mr. RITCHIE. I am very dubious of that, Senator.

Senator HUMPHREY. You are very dubious of that?

Mr. RITCHIE. Very dubious. I am very dubious of that, because whether the treatment that we give this material causes us not to have the shedding, whether the trace elements—and there are a couple of added agents there, very, very small agents——

Senator HUMPHREY. Now, you say that there are a couple of added agents. Do you mean that you add the agents?

Mr. RITCHIE. Yes, sir.

Senator HUMPHREY. What are the added agents?

Mr. RITCHIE. I would rather not say, sir.

Senator HUMPHREY. Did the Bureau of Standards ever find the added agents?

Mr. RITCHIE. They did. They did not find the right proportions of them, I think. Possibly they did not work that close.

Senator HUMPHREY. So Dr. Randall in his letter to the Bureau of Standards, which letter I have seen—that letter does not tell the whole truth, then; is that correct?

Mr. RITCHIE. That letter does not give the formula, Senator.

Senator HUMPHREY. It does not give the formula?

Mr. RITCHIE. That is correct.

Senator HUMPHREY. And the Bureau of Standards in examining your product found that there were other qualities besides that?

Mr. RITCHIE. Yes, sir. I believe that in the post-office testimony they admitted that it was the first time they had ever made a thorough analysis. And I think they showed some trace elements there that we don't know about.

Senator HUMPHREY. Now, look. Trace elements could be any one of a number of things. You could put alum in there, and it would be a trace element.

Mr. RITCHIE. True.

Senator HUMPHREY. You could put fuller's earth in there, which would be a trace element, and it most likely would be found. Now, what I want to know is, what are the chemical effects of the so-called trace elements, which take on mythical treatment here? What are the effects on the life of the battery so that it will give it this additional power and longevity that you are talking about? Trace elements could mean anything from impurities to a highly volatile chemical product. Now, what do you mean by trace elements? I do not go for this mysticism that we are getting in here.

Mr. RITCHIE. I don't care too much about it myself.

Senator HUMPHREY. Well, what are these trace elements?

Mr. RITCHIE. As I say, that is part of our formula, which I have no intention of disclosing.

Senator HUMPHREY. All right. The formula, the amounts, would be much more important than the ingredients, because surely anybody who makes an examination of this will be able to find the trace elements. I am not asking you how many grams or grains. I am not asking you how much you put into it, I am asking you, what are the trace elements and what are their chemical properties that have a peculiar reaction upon the battery plate?

Mr. RITCHIE. I am saying that I am not disclosing those things, Senator, because that information, at this time, is serving us as a patent.

Senator HUMPHREY. All right.

The CHAIRMAN. You may proceed.

Mr. RITCHIE. It is serving as a patent. If you haven't them in here, we have no way of showing it. If you haven't got them in there we don't——

The CHAIRMAN. I think at this point, Dr. Randall's letter should be made a part of the record in its full content so that we will know just what was in the letter.

Senator HUMPHREY. That is the letter of April 23, 1948. I suggest that we get a copy, Mr. Chairman, for the record.

(See p. 44 for Randall letter.)

Mr. RITCHIE. Could I take just a minute here and then go back to my files where I have this document that he is speaking of?

The CHAIRMAN. Yes, you may. We were hoping that you could go through with your statement without too much interruption, and then

we would proceed with the questions after that. We, of course, have asked a few questions, but I think that we would have a better report if you were permitted to proceed with the entire statement.

Mr. RITCHIE. Thank you, sir.

The Battery Compounds and Solutions came out of here. I still didn't give too much consideration to it. Then Keystone Batteries of San Francisco——

The CHAIRMAN. Does the reporter have a copy of the letter from Keystone Batteries?

Mr. FORSYTHE. It is in this file.

(The letter referred to appears in the appendix at p. 514.)

The CHAIRMAN. Will you take it out and make it available to the reporter?

Senator SMATHERS. Did you want to read that?

Mr. RITCHIE. Could I see that?

Senator HUMPHREY. Will you identify the Keystone Battery Co.?

Mr. RITCHIE. The Keystone Battery Co. is at 1695 Galves Avenue, San Francisco, Calif.

Senator HUMPHREY. How many years have they been in business?

Mr. RITCHIE. Many years, I understand.

Senator HUMPHREY. Do they make new batteries or recondition old ones?

Mr. RITCHIE. I believe they make new batteries in the smaller sizes and recondition batteries in the larger sizes, in the truck and bus batteries. We get a lot of their batteries in, in our shops. But I am not too familiar with their operations on them.

They put this letter out requesting the Association of American Battery Manufacturers to get in and do something about the work that we were doing, because we were costing the industry thousands of dollars. They lost a lot of business themselves. They further pointed out that the Government had been using the material, but that a purchase order had been rejected by the Government, and asked that they get hold of copies of that so that they could show that it had been rejected. I didn't know about this at the time.

Then we get the new Battery Compounds and Solutions. You notice here we are coming along businesswise. We are still on a local scale. Old customers are selling new customers, and we are moving along. We have done a lot of horse-trading with the National Better Business Bureau, and they are going to come out with something anyway. So we give them a statement, and they come out with the new Battery Compounds and Solutions, which I believe the chairman made a portion of the record previously, condemning the product by name, quoting the National Bureau of Standards, and, boy, that sold. That one really flooded.

Then Newsweek, American City magazine, Western Construction News, Western Industry, Batteryman Publishing Co., and a lot of people got hold of the story and started writing on the experiences of our customers and we decided to go national. That was a mistake, because you cannot protect yourself from great distances.

Sales really boomed. I mean, they went up and up and up. We had about 4 months in here of very good business. All this in here we have been sinking money all the way down through like this, and then we get hit with Letter Circular 504. Now, these things here are self-explanatory.

Senator FERGUSON. Tell us what 504 is.

Mr. RITCHIE. 504 is a pamphlet put out by the National Bureau of Standards condemning all battery additives. And with that, I think that I will go back to my notes, and I can make some insertions there, because otherwise I will double over on my story and use up a lot of time that is valuable.

Senator GILLETTE. Mr. Chairman.

The CHAIRMAN. Senator Gillette.

Senator GILLETTE. Just before you take your seat, to what do you attribute that immense increase in your sales after the Newsweek and other factual articles? They certainly were not an adverse effect on your business if they increased it that tremendous amount.

Mr. RITCHIE. No. The Newsweek article and these other factual articles were written by people mostly who went out and interviewed our customers, and then just wrote up a batch of articles on what they had experienced with the material. And this Newsweek article brought in some 8,000 inquiries, I believe, in a period of about 2 weeks, I believe it was.

Senator GILLETTE. And that publicity tremendously increased your business?

Mr. RITCHIE. It was tremendous. We could have set up every State in the Union. But we picked our men very carefully. We picked our distributors very carefully, because by that time I realized we were in a controversial issue. We had to pick men (1) that were well known in their community; (2) that had intestinal fortitude; (3) that believed in what was right and would fight for it. And my choices have been very flattering to me, because I think I have only lost 3 of all the distributors I set up, and 2 of them are still friends of mine. One of them is in Venezuela and the other one is in Idaho. They both let me know, when they found out about this, that they would be very glad to come up here and testify, even though they lost a lot of money in this.

Senator HUMPHREY. May I ask this question? Do you give the chemical compounds to the individuals so that they can add it to their own battery?

Mr. RITCHIE. Senator, we don't work a great deal with individuals. There is only about 2 or 3 percent of our business that is done on automotive business. We prefer to work with large industrial accounts that have the battery shops and the personnel. There is a selfish reason there. In other words, we can sell a treatment for an automobile battery. We have sold one treatment. We sell a treatment and treat a forklift truck, and we have maybe sold $300 worth of treatments. So the volume is larger there. That is No. 1.

No. 2 is: You can tell the man to put it in his car battery. He may or may not know enough about batteries to use the material right, treat a battery when it is in the proper condition, and he may know that it has done him some good and he may not. If he has trouble, he is going to do some talking. If you give it to a man who is a well-trained battery man, he knows what he is doing. He knows what he gets for his money, and we get larger sales that way.

It is just a lot better result, up until this time. We hope when it is all cleared away, we can sell it to you, and you, and you.

Senator HUMPHREY. You advertise an AD–X2 service system; is that not right?

Mr. RITCHIE. That is right.

Senator HUMPHREY. You do not advertise just AD–X2? You advertise the AD–X2 service system; is that not right?

Mr. RITCHIE. We bring our distributors into Oakland and give them firsthand training. We don't have a distributor who can't build a battery for us.

Senator HUMPHREY. That is right. In other words, you give a complete battery renovation; is that not right? Or recondition?

Mr. RITCHIE. Right.

Senator HUMPHREY. Is it not true that you can take a battery and by giving it reconditioning, if it has reasonably good qualities left to it, will stimulate its usefulness and increase its life?

Mr. RITCHIE. The time——

Senator HUMPHREY. What I am getting at is, you do more than just add a chemical; do you not? You clean the plates; you take out the sedimentation; you reprocess the whole battery? In other words, you take it apart. You really do it. It is a sort of reconditioned battery?

Mr. RITCHIE. We don't do that any more, Senator. We did that at one time, training our people, No. 1. No. 2 was that during this situation here where we were practically locked out of new accounts due to this disastrous publication by the National Bureau of Standards and National Better Business Bureau, we could sell a battery and give a full money-back guarantee on it, which we did. New batteries are sold on a prorated guarantee but we did not prorate our guarantee. We give a full money-back. If you are using one of our batteries and it quits, you can have all your money back or you can have a new battery without cost. And incidentally, the battery people resented that, believe it or not.

Senator HUMPHREY. Surely.

Mr. RITCHIE. But I would like to answer your question. The time was when you could pull a battery down and put in new separators and clean the case out and even in some cases you put in new positives and used the old negatives. We never did that. We always used all used material. But in automotive batteries, especially, that day is passed, because the plate has been thinned down. Where there used to be ninety thousandths for the negative and one hundred and eight thousandths for the positive, you find them running sixty-two thousandths for the negatives to seventy-two thousandths for the positives. So that grid is so fine that when you get a little resistance in the plate, if you go ahead and charge the battery out, under the method you are thinking of, the water cure, your grid goes out first, so that you have the condition that I demonstrated when I first started working over there. So you have to have something to lower the resistance so that the active material will take the charge, so that the grid itself will not be peroxided out due to the passing of the oxygen. Otherwise, you can rebuild a battery, and it is sulfated like that one over there [pointing to battery]. Put it on charge, charge it up, the hydrometer rises, and it shows good. Testwise, like the one I put on there, it doesn't show so well. You pull it out of the case, and it falls apart because your grid is no good.

Senator HUMPHREY. As I understand, as late as 1951, you were offering this full reconditioning service; is that correct?

Mr. RITCHIE. Yes, that is true.

Senator HUMPHREY. And you are no longer offering that full reconditioning service?

Mr. RITCHIE. Some of my people are; yes. Some of them are yet. Some of my distributors are. I am not. I have a distributor there locally in Oakland who——

Senator HUMPHREY. I mean, your product is used in conjunction with the full reconditioning service; is it not?

Mr. RITCHIE. Not necessarily. For instance, in Arabia, where we have sold material, over there, our men had never seen it. And they extended the life expectancy of the batteries over there somewhat better than three times.

In the Oakland Police Department, we never touched their batteries. When they buy new batteries, they treat the batteries before they put them in service, and they find out that they get about 2½ times as much life out of them as they do without treating. The material that went to Guam, the first thousand treatments we sent out there, they just brought the batteries in, treated them, and put them to work, and they found they got a little better out of their junk batteries than they did in their new batteries untreated.

This material can be put in a new battery. That is when it is in the best mechanical condition. This material will not make any mechanical repairs. It will simply prevent mechanical deterioration, or help prevent it.

Mr. Chairman, may I work from my book?

The CHAIRMAN. Indeed.

Mr. RITCHIE. Thank you, sir.

Incidentally, gentlemen, this is my wife, who is helping me here. She has been doing that for many years. After our children were grown, all she had to do was just help me.

About the only good Government customer we have left is the National Bureau of Standards. We have sold them over $300 worth of material since February 29, 1953.

Senator FERGUSON. Apparently the fraud order did not apply to them.

Mr. RITCHIE. I guess it did not, Senator.

On this trace-element situation, I would like to start off with an article here, out of the Wall Street Journal, speaking of the Electric Storage Battery Co.:

> After 3 years, Mr. Lighton had the battery removed for recharging. The 1 normal lead-acid cell needed replacement, but the 2 lead-silver alloy cells were still in good shape, he said. Almost 6 years after the test had started, the normal cell again was ready for the scrap heap, but the 2 original lead-silver cells were still in working condition. * * *
>
> Use of silver in batteries was a departure from long-accepted production methods. Before the turn of the century, it was found that traces of such elements as silver, bismuth, zinc, and copper in lead ore—the industry's basic raw material—could render a battery useless.
>
> Minute amounts of these substances sometimes found their way into battery plates despite efforts to refine them out of the lead ore used and wide variations in battery life were attributed to their presence.
>
> Analyzing by spectograph the amounts of these elements in thousands of battery plates, Exide engineers determined that the all-important factor in battery life was not the presence but the ratio of the various trace elements to one another.
>
> This finding brought about a complete switch from the engineers' previous thinking. With conclusive evidence to indicate the value of substances formerly considered harmful, Exide went to work improving its production by adding silver to lead in the positive plate of its batteries.

In other words, they used trace elements, and I haven't seen anybody charging them with fraud. But then they used trace elements and found out that they extended the life of the battery 5 or 6 times in this case.

I would like to make as an exhibit our advertising literature which contains all our claims for battery AD–X2, which in essence are: It reduces the harmful effects of sulfation; it extends the life of the lead-acid storage battery.

The CHAIRMAN. It will be incorporated in the record.

(The document referred to is as follows:)

[Form 90–91]

SOME BASIC INFORMATION ABOUT BATTERY AD–X2

(Manufactured by Pioneers, Inc., 2411 Grove Street, Oakland, Calif.)

[Article is reprinted by permission of The Gasoline Retailer, from p. 19, January 21, 1953, issue]

CLAIMS FOR BATTERY ADDITIVE AFFIRMED

WASHINGTON.—Claims made by the manufacturer of battery AD–X2, an additive developed to prolong the life of lead-acid storage batteries and long condemned as worthless by the National Bureau of Standards, have been substantiated, according to the findings of a report released by the Senate Small Business Committee.

The report, released by committee chairman, Senator John Sparkman (Democrat, Alabama), is based on the results of extensive tests conducted at the Massachusetts Institute of Technology at the request of the Senate committee.

This announcement "climaxes a struggle which began in 1948 when the National Bureau of Standards reported all additives containing sodium and magnesium sulfates to be worthless," Jess M. Ritchie, president of Pioneers, Inc., Oakland, Calif., maker of battery AD–X2, said following the release of the committee's findings.

REFUSED TO BUDGE

"The Bureau persisted in its blanket condemnation despite proof that battery AD–X2 contains trace elements which inhibit the shedding normally created by sodium and magnesium sulfates, and despite favorable reports from tests conducted by the United States Testing Co., the Sacramento Air Materiel Command, the University of San Francisco, and several others."

Mr. Ritchie said that when he was "unable to gain a favorable hearing with the National Bureau of Standards," he appealed to the Senate Small Business Committee for aid. With the help of California's two senators, Mr. Ritchie obtained a hearing which resulted in the committee taking an interest in the matter and the subsequent tests of the product at the MIT.

Complete substantiation of Mr. Ritchie's claims for his product is indicated in the summary prepared by chemistry professor Keith J. Laidler, of the Catholic University of America, consultant to the Senate committee. In his summary, Dr. Laidler states the tests show that battery AD–X2 will—

1. Reduce harmful effects of sulfation and extend the life expectancy of mechanically sound lead storage batteries.
2. Encourage the redeposition of shed materials.
3. Decrease loss of water.
4. Increase speed of charging and normally increase the capacity of mechanically sound sulfated batteries.
5. Protect stored batteries containing acid for longer periods against destruction by sulfation.

The full text of the report is included in the Senate Small Business Committee release SSB No. 109.

[Reprinted from October 1948 issue of Western Industry, 503 Market St., San Francisco 5, Calif.]

How To Cut Cost of Battery Repairs

(By Merle Randall, Consulting Chemist, Berkeley, Calif.[1])

Replacement of electric storage batteries that fail due to neglect or old age is an expensive item in any business or industry using batteries. To cut down soaring costs caused by the price of lead and the consequent high cost of new batteries, extensive investigation has been made to find a method of prolonging their life.

Pioneers, Inc., an Oakland firm headed by Jess M. Ritchie, has come up with a compound that seems to be an answer to the problem—although Mr. Ritchie and his associates declare that they do not know why their product works as it does. Patents are pending on their additive salts known as AD–X2, and reports from use of the product in the field indicate that batteries formerly considered dead and ready for scrap have been revived to normal use, with marked reduction in the amount of "shedding" of active material that was a weakness of previous battery additives.

A common cause of battery failure is neglect in keeping the electrolytic fluid at proper level through addition of pure water. Normally, water escapes through evaporation, and in overcharged batteries it is also decomposed and escapes as oxygen and hydrogen. This is known as "gassing." Overcharging tends to loosen the active material in the plates, which then sinks to the bottom of the container as battery mud.

If active material shrinks away from the grid there is a tendency for the evolution of gas on overcharge to take place on the grid bars, thus increasing the tendency for the grid to corrode and fail mechanically. Corrosion of the positive also causes excessive self discharge of the negative plate due to the antimony dissolved into the electrolyte from the positive grid.

AGING OF LEAD SULFATE

On discharging a storage battery, the gray sponge lead in the negative plate is transformed electrochemically to lead sulfate, and the reddish lead peroxide in the positive is also transformed into the same lead sulfate. On charge, the lead sulfate is changed back to sponge lead and lead peroxide.

When the lead sulfate is newly made in the plate it is very minute, soft, and porous, and in this condition it is easily reconverted during the charging cycle. But lead sulfate "ages" rapidly, forming the more perfect ordinary lead sulfate crystals, and this aging, or crystal growth, takes place more rapidly in warm acid than cold. It has been observed that batteries used in warm climates fail more rapidly, and likewise, the hottest cell in a battery always fails first.

Certain foreign ions in the electrolyte interfere with the aging of lead sulfate, a phenomenon well known to the chemist. While the beneficial action of certain salts has long been known, it was also found that, unfortunately, the tendency to shed active material was also increased—and of what use is good sulfate if it is not on the plates? Therefore, the addition of salts to the electrolyte has been frowned upon. If no additive is used, the active lead sulfate is allowed to age to form hard, inactive "sulfation" which cracks away from the grid and fails to be reconverted to lead peroxide and lead oxide on charging.

Development of AD–X2 appears to answer previous objections to use of additive salts. Tests show that after a few cycles where it has been used, the active material is found to be soft and in firm contact with the grid. So far as has been observed it remains tight to the grid during the entire remaining life of the battery.

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[1] The late Dr. Merle Randall, A. B., M. A., Ph. D., Professor Emeritus, University of California; coauthor "Thermodynamics and the Free Energy of Chemical Substances"; coauthor "Elementary Physical Chemistry"; under whose direction Battery AD–X2 was developed and tested. Consultant to Pioneers, Inc., from August 1948 until his death in March 1950.

What Battery AD–X2 Means to You

BATTERY AD–X2 SERVICE OFFERS YOU LOWER BATTERY REPLACEMENT COST, FEWER BATTERY REPLACEMENTS AND BETTER BATTERY SERVICE

Many large industrial accounts have cut their battery-replacement cost by well over 50 percent and lowered their electrical maintenance over the past two and one-half years by the adoption of AD–X2. AD–X2 means less down time on equipment which is the most costly result of battery failure.

WHAT YOU SHOULD KNOW ABOUT BATTERIES AND AD–X2

What is the normal life of a battery? The life of a battery depends upon a number of things. The number and capacity of the plates and other details of construction enter into the picture. Operating and storage conditions, attention to servicing of the battery, climate, and accidental breakage can and do affect the life of a battery.

2. What are the causes of battery failure? "Sulfation" is the direct or indirect cause of approximately 70 percent of battery failures.

Approximately 30 percent fail because of mechanical failures, such as from decomposed plates, buckled plates, split separators, broken cases, broken posts or anything which might cause a short circuit in a cell. Many of these mechanical failures are through no defect in the battery. A progressive battery program using AD–X2 can eliminate a large part of such failures.

3. Note: All reference to a "battery" in this pamphlet are to the usual automotive battery which is a wet battery of the lead-acid type. The size or ampere hour capacity is immaterial for purposes of this discussion, except that the regular package of AD–X2 is sufficient for a group 1 or a group 2, six-volt, three-cell battery. To determine proportionately larger treatments of AD–X2 (see paragraph 33).

4. What is "sulfation"? "Sulfation" is a colloquial name for the formation of hardened sulfate in a cell.

5. How does "sulfation" harm a battery? "Sulfation" slowly kills a battery by coating the grids and the active material of the plates. It thus prevents the free flow of electrical energy through all the parts of the plates.

6. Is this the only way "sulfation" harms a battery? No. Bubbles of gas discharged under the hard "sulfation" may cause shedding. Spot sulfation can and does cause buckled plates, cracked cell partitions, broken grids, and split separators.

7. What is lead sulfate? Lead sulfate is the substance formed in the normal chemical action of the acid electrolyte (battery fluid) on the active material in the plates of a battery, during the normal discharge of the battery.

8. Is battery mud injurious to batteries? In small quantities, battery mud is not particularly harmful. However, when it accumulates sufficiently to touch the bottom of the plates, it shorts out the plates and causes what is commonly known as a dead cell or even a dead battery. Prolonged overcharge increases battery mud.

9. Can "sulfation" be removed from a battery by an electrical charge? "Sulfation," if not too severe, can be transformed to active material, to some degree at least, by a series of charges and discharges.

10. Can the difference between mechanical shorts and "sulfation" be determined by ordinary tests for batteries? No. Broken cases, broken posts, or spilled electrolyte can be seen. Specific internal defects cannot be determined by outside appearances.

11. Can mechanical defects be repaired by other than mechanical means? No. Mechanical defects must be repaired mechanically.

12. Has AD–X2 been laboratory tested? Yes. By the Massachusetts Institute of Technology under the auspices of the Senate Select Committee on Small Business, as well as other nationally known laboratories.

13. Has AD–X2 been field tested? Yes. By the Army Air Force, by many nationally known commercial organizations, and other governmental agencies over the past five years. Laboratory and field testing of AD–X2 is finished.

AD–X2—ITS VALUE

AD–X2 reduces the harmful effects of sulfation and extends the life expectancy of lead-acid batteries.

14. Will AD–X2 dissolve "sulfation"? Yes. When a "sulfated" battery is treated with AD–X2, the "sulfation" gradually lessens with charge and discharge

or use of the battery. The hardened "sulfate" is slowly converted into soft, active material in firm contact with the grid.

15. What length of time is required for AD–X2 to lessen "sulfation"? Within thirty to forty minutes, with AD–X2 and charging, the "sulfation" will begin to disappear from the plates of the average battery. Several weeks are required to clean up a sound but badly "sulfated" battery. AD–X2 encourages the net redeposit of shed material through electrophoresis. The surface of a fully charged, restored plate is soft and metallic, with the active mass in firm contact with the grid.

16. When should AD–X2 be added to a battery? AD–X2 should be added before "sulfation" begins.

17. When does "sulfation" begin in a battery? A new battery begins "sulfating" immediately after the acid electrolyte is added. A new battery, without being used at all for a period of six months, may "sulfate" so severely that charging cannot eliminate the "sulfation."

18. Should AD–X2 be added to a new battery? Yes. AD–X2 added to a new battery will keep the plates clean, thus resulting in maximum efficiency. When "sulfation" is absent, the plates can operate as the manufacturer intended. They will operate with less heating, hence less danger of the plates buckling, because the plates are clean.

19. Does AD–X2 do more than lessen "sulfation"? Yes. AD–X2 assists the action by which the active material is kept in firm contact with the grid. The resistance of the battery, therefore, remains low and the porosity of the plates high.

Plates with the active material in firm contact with the grid, shed only to a slight degree.

20. Does AD–X2 add any electrical energy to a battery? No. AD–X2 functions only while an electrical charge is being inducted from outside the battery.

21. How rapidly should a battery be charged when treated with AD–X2? During the first hour never charge a sulfated battery more than 5 amperes. Then with AD–X2, it is safe to step the charge rate up to any value as long as the temperature remains within 10° F. of the original temperature at time of treatment. (See paragraph 26.)

22. How long is required to secure a full charge in a battery? The time varies according to the charger and the degree of "sulfation" in a battery.

23. What is meant by a full charge? For a 20-hour rate, 105 amp. hour battery with a discharge capacity of 300 amperes for 5 seconds to 4.2 volts at 0° F. represents full charge.

24. Important: Since batteries do not fail through sulfation on life cycle test, AD–X2 does not show its merit on this test. If comparison is desired, treat some cells and leave some untreated, when put on charger. Do not first attempt to charge cells, then treat, for comparison as prolonged charging on badly sulfated plates, prior to treatment corrodes the positive grid. Do not capacity test treated batteries at more than 40-amp. discharge until batteries are desulfated. As plates are hard internally and may break at high current rates. (See paragraph 15.) Mechanically sound sulfated batteries are ready for normal use as soon as charged after treatment.

25. Does the use of AD–X2 affect the hydrometer reading? Yes. AD–X2 results in slightly raising the specific gravity of the electrolyte.

26. Should dead batteries be given special treatment? Yes. Dismantle, make necessary repairs, and treat with AD–X2. Bring to full charge. This is indicated by an individual cell charging voltage of 2.5.

Test with hydrometer and volt meter.

Discharge at 40-ampere rate if hydrometer reading is below 1240, to a terminal voltage of 5.1.

If the second charge is over 1280 draw off acid and add enough water to lower to 1280.

If hydrometer shows less than 1225 draw water and add 1400 acid until a reading of 1250 or better.

For further information on "junk" batteries send for free Battery Overhaul Instructions.

27. Should AD–X2 be added to used batteries? Yes. Provided the battery is examined by a competent battery man and found to be mechanically sound. In the absence of a competent battery man, treat only those batteries that are in operating condition and are six (6) months old or less if in a composition case or twelve (12) months old or less if in a rubber case.

28. Warning. There is usually a right and a wrong way to use a product. Use AD–X2 the right way and insure getting the best results.

Warning. Satisfaction is guaranteed provided you:

1. Apply AD–X2 to Mechanically Sound Batteries.
2. Thoroughly clean battery posts, cable terminals and top of batteries and keep clean to insure good connections and reduce self-discharge.
3. Completely dissolve AD–X2 on top of plates with syringe.
4. Where batteries are treated in equipment run motor for 30 minutes immediately after treatment. When charger is being used, place battery on charger and treat within 5 to 30 minutes while charging current is being applied.
5. Maintain your batteries in accordance with good battery practice.
6. Maintain the electrical system operated by the batteries in first-class condition.

29. Warning. Too often good batteries are condemned because of faulty electrical systems. Save money and trouble by having the electrical system checked before condemning a battery. Remember: A battery with a dead cell will not start a car at any time.

30. In the absence of an experienced battery man with a well-equipped service shop send your junk batteries to an authorized AD–X2 Service-Dealer for inspection, repair, and treatment.

31. AD–X2 contains no material known to be injurious to storage batteries of the lead-acid type.

32. Directions:

1. Clean top of battery and posts.
2. Cover plates with water.
3. Treat directly into battery.
4. Dissolve AD–X2 on top of plates with battery syringe.
5. Treat new and operating batteries for minimum maintenance cost and longer life expectancy.

Clean top of battery and posts and keep clean.

Treatment good for life of battery. AD–X2 remains in the battery with acid. Group 1 or 2 battery, one envelope to each cell; group 3 or 4 battery, two envelopes to each cell; 160 amp., 12-volt battery, 2 envelopes AD–X2 to each cell.

33. On batteries that are larger than shown on package treat by volume content. One small envelope per quart or major fraction thereof. That is, multiply the length by the width by the height of the cell cavity in inches and divide by 58. This gives you the quart content of the cell by volume. Do this by measurement. Do not use outside measurement as shown in battery manual. There is no danger of overtreatment. All reference to an envelope means one of the three small envelopes as contained in the treatment package. That is the regular package of AD–X2 which is sufficient to treat a group 1 or 2, six-volt, three-cell battery.

34. AD–X2 is packed, three envelopes per treatment package, 12 treatment packages per carton, 25 cartons per case. When ordering, order in multiples of 12 treatments.

Based on present list prices, AD–X2 extending the life of a salvaged battery less than two months pays for treatment. Hundreds of batteries treated with AD–X2 from salvage are now in their second year of trouble-free service. These batteries have been serviced by experienced battery men.

35. Use the ordinary temperature corrections for specific gravity.

Suggested uses of AD–X2: Add to new batteries as "sulfation" preventative. Add to dry-charge batteries when electrolyte is added, when battery is put into service. Add to all batteries to be stored charged and to all batteries to be left in equipment while stored as a "sulfation" preventative. Add to all batteries after dismantling for inspection and repair. (See paragraph 26.)

36. To treat new and operating batteries clean top of batteries, posts, and terminals and apply AD–X2 as per directions. Your equipments electrical system will work the battery out for you. Training will be furnished on request in the use of Battery AD–X2 and the AD–X2 service system without cost to industrial battery technicians and Battery AD–X2 service dealers.

AD–X2 is not a cure-all, but a simple, easy, economical way in which to combat "sulfation" which is the cause either directly or indirectly of most battery failure.

[All numbered paragraphs, except 12 and 13, edited and approved by Dr. Merle Randall]

WHAT IS BATTERY AD–X2?

Battery AD–X2 is a specially prepared compound of chemicals containing sodium sulfate and magnesium sulfate which have been so treated that operating experience has shown the treatment to persist after its addition to the electrolyte of the lead-acid storage battery.

WARNING—BEWARE OF IMITATIONS

The materials in Battery AD–X2, unless properly manufactured, will ruin lead-acid batteries. Accept no substitute—look for the picture and signature of Jess M. Ritchie on each treatment package.

Use in mechanically defective batteries at your own risk.

"IMPORTANT"

Battery AD–X2 has never been known to fail to function chemically.

Question: Why is Battery AD–X2 not used by the battery manufacturers?

Answer: Would you adopt the use of a product in your operation which could very well cut your sales potential in half?

Used in 104 police cars.—Radio, lights, and heater, plus long idling periods, puts severe strains on police car batteries, but R. B. Lohry, Engineer in Charge, Radio Division, City of Oakland, who has been using Battery AD–X2 since 1947, writes: "Based on our experience with your product over a period of more than four (4) years, we have found that if a new battery is treated with Battery AD–X2 and given an equalizing charge prior to installation, it is estimated conservatively that the life expectancy will be extended two and one-half times the normal life before failure."

Battery AD–X2 keeps lead-acid batteries stronger . . . longer!

Manufactured by PIONEERS, INC., 2411 Grove St., Oakland 12, Calif., Manufacturers of Battery AD–X2 and Distributors of the Battery AD–X2 Service System.

You Protect . . . Upholstery with seat covers . . . Radiator with anti-freeze . . . Finish with wax.

Now protect your battery with Battery AD–X2.

Mr. RITCHIE. Since there has been considerable discussion during this argument with the Bureau of Standards as to whether or not batteries failed with sulfation, I would like to incorporate a statement by the Sun Electric people, who make this instrument here, who are not in the battery business, and who state that batteries very seldom or never failed due to any other cause except sulfation.

I would like to make this a part of the record.

The CHAIRMAN. It will be made part of the record.

(The statement referred to is as follows:)

STATEMENT BY SUN ELECTRIC CO.

THE ANSWER TO TODAY'S BATTERY TEST PROBLEMS

The following material is continuity to be read following the chart under which it appears. Turn to the next chart shown as soon as you have read all the material directly above it.

Today—batteries are failing at the highest rate in history

During the last hour, more than 1,236 batteries failed for their owners, cars wouldn't start, and owners had to walk or call for service. This outstanding figure is an actual breakdown of the 1950 report from the AAA, which had 10,850,000 calls for battery service in 1950. Add to this the number of unreported calls from people who are not AAA members, and were stalled along the road because their batteries failed. It makes a staggering total. And believe it or not—

More batteries require service than tires

Up until 1950 tires were the cause of more AAA service calls than any other item. But this last year battery failures were at an even higher rate than tire failures, yet the car has 4 tires and only 1 battery. Every time you see a motorist fixing a flat tire on the road, another motorist is having battery trouble Many of your customers are among those experiencing these battery failures But—

Are you getting your share of this business?

You're not, unless you are servicing as many batteries as your neighborhood gas station services tires.

Battery servicing is big business. It's profitable business. And tonight we want to show you how you can get your share of this business. Let's start by taking a look at the cause of all this trouble, the battery.

Acid acting on lead plates makes the battery work

The battery really consists of little more than a black box filled with lead plates and acid mixed with water. When a load is placed on the battery, the acid combines with the lead in the plates to create electricity.

What's left after the acid reacts with the plate is lead sulfate, a combination of sulfuric acid and lead. As the battery is discharged further, more and more of the acid combines with more and more of the lead to form more lead sulfate on the battery plates. As the acid is used, the electrolyte or mixture of acid and water becomes more and more diluted.

When we charge a battery, this cycle is reversed. Forcing electricity into the battery reconverts the lead sulfate on the plates back into lead and acid.

Thus the specific gravity which we have all been measuring with hydrometers for years is highest when the battery is fully charged, and all of the acid is in the electrolyte. The specific gravity reading is lowest when the battery is fully discharged, and nearly all of the acid has combined with the plates to make lead sulfate.

Now, what can go wrong with a battery? There are a number of things:

1. A battery can lose acid through a leak or crack in the case.
2. The battery can be overheated, the plates may buckle, a separator split, and the plates short out. This runs the battery down.
3. The battery can run low on water, which causes the exposed tops of the plates to harden. Thus less usable plate is left.
4. The battery can be loose in its carrier and shake the active material or lead off of the battery plates so that it falls into the bottom of the battery box, where it is useless.
5. The battery can be covered with acid and moisture and run itself down.
6. Batteries can become worn out after very extensive use. This very seldom happens, because of battery sulfation.

Sulfation is a word you have all heard many times. Actually, the formation of lead sulfate is a very normal process. As any battery is discharged, the plate turns into lead sulfate. This doesn't cause any harm, but—

When a battery remains in a discharged state, the lead sulfate hardens on the plates—this is sulfation

Yes, sulfation is the term used to describe this hardening of the lead sulfate on the battery plates.

The longer a battery stays in a discharged state, the worse sulfation gets. At first, it is rather soft. Then it gets hard. Then, it finally becomes crystalline in form, and very brittle.

Sulfation is a major cause of battery failure—it reduces useful plate area

As you can see from the chart, sulfation reduces useful plate area by covering up all of the plate except the area shown by the arrows. The acid cannot act upon the plates through the sulfation. The acid can act only on the clean-plate area, as indicated by the arrows.

When this happens, the usable battery-plate area is actually very small. Now your battery acts just like a little battery.

When you try to discharge the battery it has very little current output. When you try to charge the battery, it acts immediately like a fully charged battery, and keeps the regulator and generator from charging it.

A battery that is sulfated like the one shown here cannot supply the normal amount of current for starting, and other electrical accessories. And when you start out in the morning with your automobile, the charge indicator swings

over to the right-hand side of the scale and very shortly returns to zero. You sit back contentedly thinking that your battery is already fully charged. Little do you know that the battery is not charged at all—but sulfated, and its action makes you think it is fully charged. A sulfated battery can become so bad that it will no longer start an automobile, and yet the reaction on a charge indicator when you start your car in the morning is still just the same as it was on a good new battery.

Here's why a sulfated battery causes so much trouble—

Sulfated batteries require higher voltages to charge them

A sulfated battery, almost completely discharged, often will only accept a few amperes of charge from a normal charging system. However, when a good battery drops to a specific gravity of only 1.200 it will accept all of the current that your generator and regulator can put into it at less than the normal voltage regulator setting of about 7.4 volts.

The regulator is a device which merely controls generator voltage and maximum current output to normal requirements. It's up to the battery to regulate the amount of current that flows into it by changes in battery voltage as the battery becomes charged or discharged.

As soon as a normal healthy battery becomes partially discharged, it will accept the full output of the charging system at less than its regulated voltage. As a good battery becomes fully charged, its voltage rises bucking the voltage of the charging system, and reducing the charge rate to the battery.

A sulfated battery on the other hand has less battery-plate area exposed. This small plate area soon becomes charged, and the battery voltage rises shutting off the flow of current from the generator and regulator. The sulfated battery, however, is not charged because there is still lead sulfate on much of the plate surface.

A higher constant charging voltage is required to break down the sulfation and reconvert the hardened lead sulfate back into active plate material.

It doesn't do any good to try to raise the voltage-regulator setting and force current into a sulfated battery in a car, because this higher voltage setting would damage the lights, ignition system, radio, and other electrical accessories. Also, the automobile usually is not driven at high enough speeds and temperatures to break down this battery sulfation.

So we really have a problem. The sulfated battery will not accept the charge at a normal voltage-regulator setting, and we cannot raise the voltage regulator-setting to force a charge into the sulfated battery because this would damage other electrical units on the automobile.

And to make matters even worse—

Sulfation starts whenever specific gravity is below 1.250

Think about the batteries on your parts-room shelf right now. Are every one of those batteries charged to 1.250 specific gravity or more? I'll bet they aren't. And the longer they stay that way the worse the sulfation gets. Maybe you're beginning to think now that you know one of the reasons why your new batteries sometimes didn't work out so well when you put them in a car.

Think about your new cars waiting for delivery too. How many of those batteries are charged to 1.250 or more? If they aren't, those batteries are sulfating right now, inviting trouble which will bring the customer to your service door as soon as cold weather hits, if not before.

Sulfation can start more quickly than you might think. Sulfation starts whenever the battery drops below a specific gravity of 1.250. With batteries in stock and in new cars this doesn't take long because "batteries in stock and in new cars may drop from full charge to less than one-half charge in as little as 30 days."

Yes; that's right. A battery can drop from a fully charged specific gravity of 1.270 down to a specific gravity of 1.210, less than half charge, in less than 30 days under most storage conditions prevailing throughout the country right now.

Batteries stored at normal room temperature will lose approximately 2 points of specific gravity every day. If the temperature of the battery in storage is high, the rate of self-discharge increases to 3 points of specific gravity every day.

Yet you will see batteries stored in bright sunlight in a hot showroom window in the middle of the summer. And in winter, to keep them warm, people store batteries in boiler rooms. Both of these conditions are exceptionally hard on the battery. Remember, the higher the battery temperature the faster the battery will self-discharge or run itself down.

Batteries should be stored in as cool a place as possible.

As an example, a battery stored at 80° F. will lose half of its charge in about 30 days. A battery stored at 60° F. will lose less than one-quarter of its charge in the same period. A battery stored at 0° F. will lose almost no charge in 30 days.

"The only way to prevent sulfation is to keep the battery fully charged"

Because when the battery is fully charged there is no lead sulfate on the battery plates to harden. Keeping the battery fully charged requires three things: First, a fully charged battery to be placed in storage; second, a cool place to store the battery where the battery will not run itself down rapidly; and, most important of all, a recharging program must be used to keep the battery charged at all times.

Yes, the only way to prevent sulfation is to keep the battery fully charged. But how about all of those cars you serviced in the last 6 months? How many of those cars that left your service door had batteries charged to 1.250 or more? Many of those that weren't are going to be back with trouble, and even worse many of them won't come back to you with trouble, but will go some place else for service. You're probably not open late at night when batteries usually fail, but your corner gas station is. That's where most of your battery business is going now.

Sure, we've all made mistakes in servicing batteries, but you are probably wondering, like many others, "What is the answer to all of this?" Well, we've already discussed what we can do to prevent sulfation of batteries in the future, but now let's face our greatest problem—how to find and correct this condition called sulfation in the millions of batteries now in use. The method is proven now—

Here's how you can find sulfation and other battery troubles and it's as simple as this—

If the battery has current in it, test it by measuring its output.

If the battery doesn't have current in it, test it by passing current through it.

Here is the first step. Use the battery starter tester to test battery capacity.

Battery capacity test

The battery is:

1. Good, or
2. Needs a test charge.

Connect the ammeter and voltmeter leads to the battery posts in the proper polarity. Turn the control knob clockwise until the ammeter reads three times the ampere hour rating of the battery. For example, if this were a 115-ampere-hour battery, I would place a load of 345 amperes on the battery.

Hold this load on the battery for 15 seconds and watch the voltmeter. A good battery will usually measure over 4.8 volts, and 4.8 volts is the minimum for a good battery.

However, a battery may measure over 4.8 volts but still be somewhat less than fully charged, so if the battery tests good on the first test, measure the specific gravity and charge the battery if the gravity is less than full charge.

However, if the battery voltage was less than 4.8 volts during this capacity test, we can't say the battery is bad, we can't say its discharged, all we can say is the battery needs a test charge.

Remember, don't condemn a battery just because it won't hold 4.8 volts. This may be a good battery run down or discharged, or it may be a bad one. We don't know yet until we make our next test which is the one that really gives us the answers we want on batteries that do not have enough output to pass the battery capacity test. Here it is:

Test-charge

The battery is—

1. Good; will take a fast charge.
2. No good.
3. Sulfated; needs slow charge.

Remove the battery starter tester leads. Connect the fast charger leads and plug the charger into any 110 volt a. c. outlet. Turn the time switch to 3 minutes and turn the charger control to maximum or 75 amperes.

Let the charger operate for 3 minutes. When it clicks off, turn it right back on because we want to test this battery with charging current going through it. Remember this test charge is used only on batteries which did not have enough current output so we are testing these batteries by putting current through them.

After waiting for 3 minutes, and with the battery still on fast charge, test cell voltages. They should be even within 0.2 volts. If they are not, the battery is bad.

If the cells are even within 0.2 volts, test the total battery voltage under charge. If the voltmeter reads less than 7.75 volts, this is a good battery. It is only discharged and, what is more, this battery will take a fast charge.

When I say the battery will take a fast charge, I mean that if its voltage stays below 7.75 volts for the first 3 minutes, you can charge the battery at 75 amperes for up to a full hour. It will not gas, it will not bubble, it will not boil, it will not spout electrolyte. It will safely take a fast charge, and without overheating.

However, if the voltage rises above 7.75 volts in the first 3 minutes of charge, you've got trouble. The battery is probably sulfated. And, in its present state, the battery is not suitable for use in an automobile. Remember, any battery you test charge did not have enough output to pass the capacity test. Now, this same battery won't accept a charge either. That must mean that the battery does not have enough active plate area.

If your customer is in a hurry, he may decide to replace this battery with a new one. However, if time permits, it would probably be advisable to remove the battery from his car, put in a loaner, and place his battery on a continuous slow charge to see if the sulfation can be broken down and the battery returned to a serviceable condition.

Did you say you don't have loaners? Well, if you want to service sulfated batteries properly, and take care of your own warranty batteries, you will either have to get a few loaners or ask the customer to leave his car for 24 hours, so you can take his battery out, clean it up, and give it a slow, continuous charge to break down the sulfation. After the battery has been charged until the specific gravity will not rise for three consecutive hourly tests—yes, that's what I said; test the gravity every hour and when the specific gravity does not rise for 3 hours, the battery is fully charged and is as well desulfated as you will probably be able to get it. When you've done this, test battery capacity again. If it is above 4.8 volts, you've got a good battery. It's a live one. It will charge; it will discharge. Put it back in the car and don't worry about it.

But, if after the slow charge the battery will still not pass the battery capacity test, your best bet is to put another battery in the automobile.

We can't guarantee that these batteries which failed the capacity test and will not accept a charge at less than 7.75 volts with even cell voltages will come back after a slow charge, but experience has shown that in most cases it is worth while charging the battery because a sizable number of them can be returned to service. At least if you sell a new battery you might try charging some of these and see if you can't make some good loaners for your own battery servicing.

All right, now that we have the story, let's go over it once more, just to make sure.

Note to speaker: Turn back to battery capacity chart.

When a car comes in with battery trouble, or you want to test a battery in the shop, the first thing you want to do is pick up the battery starter tester and test battery capacity. Don't worry about the specific gravity now; that can be taken care of later. Test the battery capacity. The battery will either be good or need a test charge. If it is good, huse a hydrometer to see if it needs any charging. If it will not pass the capacity test, give it a test charge.

Note to speaker: Turn to test charge chart.

The test charge gives us two indications.

1. The voltage at which the battery will accept a fast charge.
2. The similarity of cell voltages under charge.

Regardless of the total voltage under fast charge, the battery is bad if cell voltages vary more than 0.2 volt.

If cell voltages are even within 0.2 volt under fast charge, the total voltage under fast charge tells us what type of charging the battery will accept.

Batteries below 7.75 volts under fast charge will safely accept a fast charge for up to 1 hour.

Batteries over 7.75 volts under fast charge are sulfated and must be slow charged until specific gravity stops rising.

That's all there is to it, fellows, these four simple steps. Just two tests, a battery capacity test and a test charge. They will give you the answers you want.

Remember, now you can tell whether a charged or discharged battery is good or bad in less than 4 minutes.

You can test the battery if the car comes in the door and won't even turn over the engine, because the battery is so dead. It doesn't make any difference. With this test procedure, you can find the answer to a live one or a dead one.

Just remember one thing—if the battery is cold, you will have to let it warm up before you can use this test procedure.

So, why not take advantage of all the battery business that's just waiting for someone to grab it.

Start testing batteries today

If you do you gain four ways—

1. You sell more batteries, because you're testing batteries and finding out what is wrong before they quit. You're doing your customer a favor.
2. You gain because you sell fast and slow charging, and bring in increased revenue.
3. You gain because you sell charging system corrective work, uncovered by a battery that was not being kept up to charge.
4. You save time, because you no longer need to wait for 8, 10, 12 hours or more while you charge a battery before you can say whether it is good or bad. You can do it in 4 minutes, and satisfy your customers.

Accept and use this slogan. It will make you money, get more customers, and make your business both healthier and happier.

Test—don't guess

Note to speaker: Start the following demonstration as soon as presentation is completed.

Demonstration of battery testing and charging

Note to speaker: Place this procedure on the table before you and follow the steps listed during your demonstration. Start with the sulphated battery.

Here is a battery that could be in a car that just came in your service door. The first thing we want to know about it is what condition it's in. We'll start by making the battery capacity test.

Note to speaker: Connect leads for battery capacity test. Emphasize that voltmeter lead must be connected to battery post.

Now, the battery must be loaded to 3 times the ampere hour rating of the battery. This is a —— ampere-hour battery, so I will load it with —— amperes. The voltmeter should read 4.8 volts or more after 15 seconds if the battery is good, and charged.

This battery reads less than 4.8 volts. That means that the battery must be test charged.

Note to speaker: Disconnect battery-starter tester ammeter leads and connect B–822 charger leads. Be sure charger is plugged in. Emphasize the need for the voltmeter clips being on the battery post.

With the charger and voltmeter leads connected as they are here, the next step is to turn the time switch past 3 minutes and then back to 3 minutes. Now I'll turn the charger on to maximum. Watch the voltmeter now.

Note to speaker: Hold the battery-starter tester high enough so that all can see the voltmeter reading.

The voltmeter reading is already above 7.75 volts, indicating that this battery is probably sulphated. We can all see that the battery is not taking a charge as a good battery will.

To find out whether this battery is worth slow charging to break down the sulphation, I'm going to test the cell voltages after the battery has charged its full 3 minutes. The reason for waiting the 3 minutes is to make sure that all the cells have had a chance to become charged enough to let us make a fair test of cell voltages. A sulphated or even a good battery may have one cell that runs down just a little sooner than the others. The 3 minutes of fast charge gives this cell a chance to catch up to the others in voltage before making our cell voltage test.

Note to speaker: After 3 minutes of fast charge, with the charger on fast charge, test cell voltages, calling out the readings.

If cell voltages are even within 0.2 volt, say "This battery should be slow-charged until gravity will not rise for 3 hours, and then retested for capacity."

If cell voltages are uneven by more than 0.2 volt say "The battery is bad, and should be replaced."

Note to speaker: Turn fast charger rate down until voltage drops to approximately 7.2 volts.

I have just reduced the charge rate until the battery voltage under charge is about 7.2 volts. The ammeter on the charger only shows —— amps. That's all the current a normal charging system could put into this low battery—with a voltage regulator setting of 7.2 volts.

I'm sure you can see how many of the charging system problems you are having with your own cars today can be caused by nothing more than a sulphated battery.

Note to speaker: Disconnect charger and battery-starter tester from the sulphated battery. Connect the battery-starter tester to the other battery which will take a fast charge.

Let's try this test on another battery. We'll start by making a battery capacity test.

Note to speaker: Connect leads for battery capacity test. Emphasize that voltmeter lead must be connected to battery post.

We'll load the battery to 3 times its ampere-hour capacity, or —— amps. The voltmeter should read 4.8 volts or more if the battery is good.

This battery reads less than 4.8 volts, which means that the battery must be test-charged.

Note to speaker: Disconnect battery-starter tester ammeter leads and connect B–822 charger leads. Emphasize the need for the voltmeter clips being on the battery post.

Now that the leads are connected, I'll turn the time switch past 3 minutes, then back to 3 minutes. I'll turn the charger on to maximum. If the charge rate is over 75 amps, I'll turn the charge switch back until the charge rate is approximately 75 amps.

Look at the voltmeter now. It's reading —— volts, which is well below 7.75 volts. Let's let it charge for 3 minutes.

Just because the voltmeter reading is below 7.75 volts, I can't say that this is a good battery that will take a fast charge, because this battery may have a shorted cell which is causing the low charging voltage.

As an example, we could have a battery badly enough sulfated that the voltage of each cell rose to 3 volts under a fast charge. If one of its cells was shorted, the voltage of that cell would be zero. Consequently, the total voltage of the other 2 cells, or 6 volts, would be all that could be seen on the voltmeter. That is why cell voltages under charge must be tested to determine battery condition.

Note to speaker: After 3 minutes of fast charge, with the charger still on fast charge, test cell voltages. Call out each cell voltage reading.

If the cell voltages are even within 0.2 volt, say, "This is a good battery which will accept a fast charge. It can safely be fast charged for up to 1 hour. The fast charge should be followed by slow charging to bring the specific gravity to 1.250 or more."

If cell voltages are uneven by more than 0.2 volt say "This is a bad battery, and it should be replaced."

A fast charge should always be followed by at least an hour of slow charge to drive the charge deep into the battery plates. You increase the effectiveness of a fast charge by as much as 50 percent when you follow it by at least an hour of slow charge.

Let's look at another thing. The voltage required to push 75 amperes into this battery is less than normal voltage regulator setting. Remember the other battery that would only accept a few amperes at 7.2 volts? That is real proof of what sulfation can do to the operation of your charging system.

Remember—even the best charging system cannot operate normally without a good, healthy, active battery.

Note to speaker: Open the meeting to questions, but remember—

Repeat the question before answering it.

State your answer simply.

Refer to this material and that to follow for answers.

Above all—don't bluff. If you don't know the answer to a question, say "That's a good question. I'll find out what the answer is and let you know."

When you say this, make sure you follow it up and let the man know, or just say honestly, "I don't know."

If no questions are asked by the group, ask a few of the questions on the following pages to try to start a discussion.

Don't drag out any discussion too long, and if necessary, state the answer as shown on the following pages to end a discussion. Then ask for more questions.

Don't run overtime without the permission of the club president. Your program will be better received if it starts and ends on time.

Note to speaker :In conclusion, summarize by reading the last chart again.

You gain four ways

Close your meeting with remarks similar to the following:

"The Sun representative in your area will be glad to come to your shop, bring the equipment with him that you have seen here tonight, demonstrate the same tests to you, and let you see them actually work on your own customers' batteries. Don't hesitate to call him, as he will be more than willing to help you in battery testing in any way he possibly can. He has the equipment, he has the procedures, and he knows just what we are doing here tonight. Let him help you personally with your battery problem.

"Mr. President, Mr. (——— representative's name) and club members, it has been a sincere pleasure on my part to have had this opportunity to speak with you this evening, and I would like to thank each and every one of you for your interest, attention, and for the opportunity of being here."

DISCUSSION OF BATTERY PROBLEMS

How long does it take a battery on the shelf to run down?

That depends upon temperature. At 80° F., a drop in specific gravity of 0.002 per day can be expected. At 100° F., a drop of 0.003 in specific gravity per day can be expected. At lower temperatures, considerably less self-discharge takes place in a battery in storage.

For example, if a 1.270 battery were placed in stock at 80° F., in 30 days the state of charge would be reduced to 1.210. If the battery sat another 30 days, troublesome sulfation would have set in in addition to the fact that the battery would be still further discharged, or down to 1.150 at the end of 60 days.

Can sulfation be corrected by any means other than charging a battery on the bench?

With normal specification limits on voltage-regulator settings, a sulfated battery will never become fully charged in an automobile, except under very unusual, high temperature, high-speed operating conditions.

In nearly all cases, the battery must be removed from the vehicle and slow charged for a period of 24 hours or more, until the specific gravity will rise no further. Then the battery is about as well desulfated as you can get it.

Can the average automobile charging system recharge a discharged battery?

This depends on driver habits and the battery. If the automobile is driven for sufficient distances at sufficient speeds with a normal charging system, a healthy battery usually will become fully charged through the action of the automobile's charging system.

However, if the automobile is used primarily for city driving, with electrical accessories in use, the charging system may be able to do no more than maintain the present state of charge of the battery.

In fact, in some areas considerable difficulty is experienced because the car owner drives continually in city traffic, stop and go, with all of his accessories turned on, and the state of the charge of the battery will actually drop as the vehicle is used.

A sulfated battery usually cannot be brought to full charge with a normal automobile charging system.

Can I test-charge any battery?

No. A battery should only be test charged when it will not pass the battery capacity test.

If you attempt to test-charge a battery which will pass the battery capacity test, a normal, healthy battery will usually respond to a fast charge by a rise in voltage, because the battery is already charged.

Consequently, never fast-charge a battery which passes the battery capacity test. A good battery, as determined by capacity test or test charge, should be tested with a hydrometer to determine the amount of charging needed. If the vehicle is being driven at sufficient high speed and long distances to permit the charging system of the vehicle to charge the battery, the vehicle may safely be sent out the door this way.

However, if a good battery is low in charge, and the owner does primarily city driving, it is highly recommended that the battery be charged to at least 1.250 before the car leaves your shop.

How does this test procedure find shorted cells?

This test procedure finds shorted cells in the following way:

1. Battery capacity test. If a shorted cell exists in the battery, the total voltage under load will not be 4.8 volts or more.

2. If a battery does not pass the battery capacity test, and is fast charged, any such battery, with a shorted cell, will have more than a 0.2-volt difference between cell voltage readings under a maximum charge.

Can a fully discharged battery have 1 cell which reads lower in voltage than the other 2, and still be a good battery?

The test charge is the answer to that question. Some good batteries, in a completely discharged state will have uneven cell-voltage readings by as much as 1 volt, or perhaps more. However, if the battery is good, after 3 minutes of fast charge, the cell voltages on all 3 cells will be even within 0.2 volt. Such a battery when fully charged, will be just as serviceable as a battery which has even cell voltages with the battery completely discharged. After all, all 6 or 8 cylinders in an engine are not exactly the same size. Neither are all three cells of the battery necessarily exactly the same electrical size.

Mr. RITCHIE. Facts About Battery Dopes, by the National Better Business Bureau, that I mentioned, I would like to have made part of the record.

The CHAIRMAN. That will be made part of the record.

(The document referred to is as follows:)

FACTS ABOUT BATTERY DOPES

Useless or harmful—say manufacturers

Battery manufacturers do not put any special "dopes" in their batteries. Why? Because tests have demonstrated that these compounds are either useless or harmful.

These are the two chief reasons cited by over sixty battery manufacturers who recently were questioned on the subject in a nationwide survey conducted by the National Better Business Bureau. Battery manufacturers have made hundreds of tests on various chemicals that have been sold as panaceas for battery failure, but as one manufacturer put it:

"To date there has been nothing found which can be added to the electrolyte of a storage battery which will facilitate charging or increase the life of a storage battery.

"* * * battery dope * * * are either harmful to the life of a storage battery or have no material effect either on the life or on the charge of a battery. However, those compounds which are not harmful increase the inert material in the electrolyte and in this respect are harmful."

"Debunking" claims for "dopes"

The chief claim made for battery dopes is that by dissolving the hardened sulphate on battery plaes they keep good batteries in first-class shape and restore new life to sick ones. According to authorities on the subject, the lead sulphate which forms on battery plates is only sparingly soluble. It can be removed from lead plates adequately only by a charge of electric energy. No battery "dope" contains any electric energy. No battery "dope" has been found useful in aiding battery performance.

No beneficial effects—says National Bureau of Standards

The highest impartial scientific authority in the United States on storage batteries is the National Bureau of Standards, official testing agency for government departments. This is what its director, Dr. Lyman J. Briggs, recently said about battery dopes:

"For the most part these (battery) compounds and solutions have as principal ingredients either or both magnesium sulphate (epsom salts) and sodium sulphate (Glauber's salt). In various samples other constituents were indicated, including: aluminum sulphate, potassium sulphate, ammonium sulphate, several kinds of alum, glycerine, chromates, phosphates, sulphuric acid, salts or copper and iron, and organic coloring agents. Whatever effect these materials may have in a storage battery when added to the standard electrolyte for such batteries, this Bureau has never found any evidence that they affect the funda-

mental electrochemical reactions which occur in the battery when it is charged or discharged.

"Occasionally automotive batteries may need a supplementary charge from an external source of power. This is usually evidence of some maladjustment of the operating conditions. These 'charges' are naturally a source of inconvenience and may be misunderstood by the nontechnical public. Too often these compounds are advertised with claims that the necessity for such charges is eliminated. In any case the supplementary charge, amounting to 100 to 150 ampere-hours, is emphasized, forgetting that the generator on the car supplies several thousand ampere-hours to the battery in the course of a year. Advertising leaflets accompanying these compounds are usually careful to specify that the battery and the charging system on the car must be in mechanically good condition before using the material. If this were not so, the shortcomings of the panacea would speedily become apparent.

"It is, of course, possible that some material may eventually be found which would relieve the difficulties arising from abnormal operation of storage batteries, but none of the exploited materials which have been tested here have had any such merits. Compounds of epsom salts and analogous materials under a seemingly endless variety of trade names, indicating their intended application to batteries, have come and gone without attaining any permanent acceptance by the public or the battery industry.

"Advertising leaflets which accompany these compounds often deal in generalities and make few specific claims the correctness of which could be determined without long and expensive tests. Sometimes simple 'practical tests' are described which may lead to false conclusions by those who are not familiar with the technical aspects of the subject. The ordinary user, of course, cannot compare the efficiencies of similar batteries treated with the material and others not so treated, nor can he determine whether the material extends the useful life of his battery. Carefully controlled tests are necessary in order to determine these points definitely and *none of these materials which have been tested here have produced any beneficial effect when added to the regular electrolyte. Some are definitely harmful.*"

Use voids factory guarantee

Battery manufacturers generally sell their products with a standard warranty or guarantee against failure caused by manufacturing defects. This guarantee is voided, manufacturers informed the National Better Business Bureau, by the introduction of any battery dope into their batteries. The reason for this is that many battery compounds contain impurities which are definitely harmful to batteries. Naturally, manufacturers decline any responsibility for damage caused by tinkering with the original electrolyte.

No "dopes" for Uncle Sam

If these trick compounds that are offered to the public served any useful purpose it is obvious that they would be purchased in large quantities for use in submarines, tanks, jeeps, and every other vehicle utilizing storage batteries. Both the War Department and the Navy Department have reported that no special compounds or solutions are employed in any batteries used by the Armed Forces.

Drugstore magic

Many chemicals have been used as battery "dopes" ranging from a 0.1% solution of an organic dye in water to pure sulphuric acid. One of the most popular compounds used through the years has been magnesium sulphate which is better known to the public as epsom salts. Three-ounce packages of epsom salts, when sold as a battery "dope" command $1.50. When bought in the drugstore, epsom salts sells for 20¢ per 16-ounce package. In large quantities epsom salts can be purchased at wholesale for 2¢ per pound. Its sale at the rate of $8.00 per pound as a scientific battery compound has its magical aspects, but authorities consulted by this Bureau are unanimous in declaring that epsom salts, either alone or with any other ingredients, does not aid battery performance.

Trick tests and testimonials

Most vendors of battery "dopes" can "prove" before your eyes that their magical powders or solutions perform as claimed. They also have letters of endorsement from users who can testify that their product is useful. Don't be taken in by "trick" tests or incompetent testimony.

Any battery can be made to *appear* to be discharged by holding the foot on the starter until it no longer will start the motor. This does not necessarily

mean that the battery *is* completely discharged. The "dope" is then inserted in the battery and it may be permitted to stand idle for a short while, or the car may be cranked by hand and the motor idled for a few minutes. A foot is then placed on the starter and presto—the motor starts. The battery would de exactly the same thing under the same circumstances if no dope were added. The test proves only that a battery run down in this manner quickly will recuperate enough to start a motor. As for lay testimonials, they are no more reliable or acceptable today on battery dopes than they are on any other product that is evaluated in the absence of scientific yardsticks and procedures.

Conserve your battery—and help the war effort

Tire and gas rationing is tough on your battery because it needs a minimum of recharging by the car's generator to replace the relatively large expenditure of electric energy utilized when a car is driven only a few miles a week. Your battery may run down. If so, let your service station dealer recharge it. That is the only way you can put it back into serviceable condition. Don't seek short cuts. Don't be a "dope" yourself by expecting a "dope" to work miracles for you. When any compound is discovered that will improve on the standard battery electrolyte of water and sulphuric acid, it will be in the battery the day you buy it.

NATIONAL BETTER BUSINESS BUREAU, INC.

Division of Research, 405 Lexington Avenue, New York 17, N. Y.

Mr. RITCHIE. We have a background statement on Dr. Merle Randall, which I would like to have made part of the record.

The CHAIRMAN. That, too, will be printed in the record.

(The statement referred to is as follows:)

JUNE 9, 1948.

AFFIDAVIT OF MERLE RANDALL, OF RANDALL & SONS, CHEMICAL AND CHEMICAL ENGINEERING CONSULTANTS

I, Merle Randall, of 2512 Etna Street, Berkeley 4, Alameda County, Calif., being duly sworn, do hereby affirm that I have the following qualifications; that I have made the following observations and experiments; that for 6 years I have been the senior member of the firm of Randall & Sons, chemical and chemical engineering consultants; that I now am professor of chemistry emeritus of the University of California, and in the capacity of consultation have served as director of research for the Stuart Oxygen Co. for the past 5 years. That I am 60 years of age, graduated with bachelor's and master's degrees at the University of Missouri, major in chemistry, in 1907 and 1909; was Austin and Saltonstall fellow at the Massachusetts Institute of Technology, 1909–12, where I received the degree of doctor of philosophy in 1912, my thesis being Studies in Free Energy under the direction of the late Prof. Gilbert N. Lewis; that I accompanied Professor Lewis in 1912 to his new position as dean of the College of Chemistry of the University of California, at Berkeley, where I served from 1912 as assistant in chemistry through the several ranks of professorship until the present time, being advanced to full professor in 1927; that I have been especially active in research in the field of thermodynamics of solutions and that I have published numerous papers dealing with the thermodynamic and electromotive properties of aqueous sulfuric acid and its mixtures with salt; and that I collaborated with Prof. Gilbert N. Lewis as coauthor of Thermodynamics and the Free Energy of Chemical Substances in 1923. This book, as well as the preceding and succeeding papers which I published in the field of electrolytic solutions, pioneered the development of the modern theory of solutions and Thermodynamics and the Free Energy of Chemical Substances has been, and still is, regarded as the classic text and reference work in this field. That during World War I, under the offices of the California State Council of Defense, I cooperated with the United States Navy in the study of the problem of the elimination of hydrogen in submarines and that I made a detailed study of storage batteries at that time. That I have given numerous extension lectures under the offices of the University of California Extension Division on the subject of the lead-acid storage battery, and that I have made a substantially complete search concerning lead-acid storage batteries, especially as to anodes, cathodes, and electrolytes.

That I have taught courses in technical electrochemistry, the phase rule, quantitative analysis, physical chemistry, and chemical engineering, and that

further information concerning my qualifications may be found in such biographical directories as Who's Who in America and American Men of Science.

That I am a fellow of the American Association for the Advancement of Science, a past chairman of the California section of the American Chemical Society, and a member of the American Society for Testing Materials, American Chemical Society, American Institute of Chemical Engineers, American Society of Metals, American Society of Refrigerating Engineers, American Society of Lubricating Engineers. That I received the Bronze Medal of Merit from Charles University, Prague, in recognition of my accomplishments in the field of the thermodynamics of solutions.

Mr. RITCHIE. Here is a statement on the theory of storage batteries by the General Lead——

The CHAIRMAN. Mr. Ritchie, if I may interrupt you, is Dr. Randall's letter a very lengthy letter?

Mr. RITCHIE. Well——

The CHAIRMAN. I would like you to read that so the other members of the committee and I may have the benefit of the full content of Dr. Randall's letter.

Mr. RITCHIE. I believe that I can do that, Senator. It is about a page and a half.

The CHAIRMAN. Then take it and read it into the record.

Mr. RITCHIE. All right. First, as I said before——

The CHAIRMAN. Lay this down until you have read Dr. Randall's letter into the record.

Mr. RITCHIE (reading):

One of my clients has purchased——

Senator GILLETTE. Will you identify the letter as to the date and the addressee?

Mr. RITCHIE. The letter is April 23, 1948, and I am going to substitute in the letter the word "AD–X2" for "Protecto-Charge" in order to get away from the confusion of the two names, if I may.

Senator GILLETTE. And to whom is it addressed?

Mr. RITCHIE. Dr. George W. Vinal, National Bureau of Standards, Washington 25, D. C. [Reading:]

One of my clients has purchased the equities in a patent application (Donald E. Keifer) covering AD–X2, an addition agent for storage batteries. Frankly, both his patent attorney, a thoroughly reliable and experienced man, and I were suspicious of the claims made for this product.

Knowing of your sincere interest in this sort of matter and your expert knowledge of storage batteries, I am taking the liberty of calling this product to your attention. You, of course, know of my work in the field of electrolytic theory. Drs. Rossini and Manov worked with me for their doctorates.

I have examined the entire literature of the subject of additives. There is a very definite effect of added salts on the physical properties of lead sulfate as it is precipitated in the storage battery. (See especially Arndt, Electrotech. Zeit. 56, 122–124 (1935), and the work of Kolthoff and his fellow workers.)

The battery AD–X2 process involves the addition of a powder mixture of anhydrous sodium sulfate and a slightly basic, nearly anhydrous, magnesium sulfate to the water while it is filled with standard sulfuric acid, electrolyte. Curiously, the result is quite different from that when equivalent amounts of sodium sulfate and epsom salts are added. The active material remains "tight" to the grid and there is so little "shedding" of the active material that there is an apparent, possibly real, decrease in the amount of battery mud. The tightness of the active material to the grid results in less gassing on charging, very small bubbles distributed on the surface of the plates, rather than at the location of the grids, with the result that in a battery, one cell of which is treated, the others not treated, or treated with equivalent amounts of sodium sulfate and epsom salts, there is more evaporation and electrolysis of water than in the battery AD–X2 treated cell.

Actual large-scale fleet operational tests and repeat orders by such large operators as the Arabian-American Oil Co. in Saudi Arabia; Benecia Arsenal, Benecia, Calif.; the Ridley Co., San Francisco, Calif.; the Emeryville Fire Department, Emeryville, Calif.; McGuire & Hester Pipeline Contractors, Oakland, Calif.; Dinwiddle Construction Co., of San Francisco, Calif.; and the Bechtel International Construction Co., of San Francisco, Calif., as well as my own observations, indicate a remarkable improvement in the service of both new batteries and those discarded as sulfated in use or on the shelf. Many hundreds of batteries discarded by the armed services have been treated, sold, and have given satisfactory service.

Reductions of 85, 90, and, in one instance, 95 percent in annual battery expense during the past year has been reported by large firms, some of which have always had an intelligent battery-service program. These operational service results are, after all, not wholly to be disregarded.

I am calling this matter to your attention because of the enormous potential effect which these developments can have in connection with the servicing of the "mothball fleet" and the Army reserve equipment, as well as its effect on the practical conservation of lead, one of our vitally essential materials.

I have personally reviewed the claims made on the enclosed circular. I believe they are conservative. Pioneers, Inc., is making a sincere effort to market their product on a high plane. They have dealt largely with large-fleet operators who are in a position to evaluate the results obtained with the product.

With kindest personal regards, I am,

Sincerely yours,

MERLE RANDALL.

We never got an answer from that letter.

Senator FERGUSON. What was the occasion of writing it?

Mr. RITCHIE. This letter—Circular 302, which I mentioned in the first place came to my attention, and I mentioned it to Dr. Randall. We didn't have a copy of it at the time, but Dr. Randall thought that in order to prevent misunderstanding, he should write to the Bureau of Standards, which he did. You notice that he never asked for any test. He just simply stated the case in the letter. We never got an answer to that letter, and he wrote again on June 25, 1948, and the third paragraph of that letter states:

When a "sulfated" cell is left untreated, it often reverses during the test, and it is difficult to obtain a full 300-ampere discharge on the breakdown. If one of the cells is untreated, a second treated with already known additives, e. g., mixtures of glauber's and epsom salts, and the third with AD–X2, there may not at first appear to be more than a slightly favorable effect for AD–X2, but shedding soon becomes evident with epsom salt treatments. On the prolonged overcharge, the epsom salt treatment will fail much sooner than with the AD–X2, probably because of the much smaller bubbles evolved at the surface of the active material with AD–X2 as compared with the larger bubbles mostly in the vicinity of the grid bars with epsom. Of course, all this time, the untreated cell is out of the picture, as it will not ordinarily gain sufficient capacity, and the violent discharges and reversals will result in rapid further deterioration.

With kindest personal regards, I am,

Yours very truly,

MERLE RANDALL.

Senator GILLETTE. Is that dated the same year?

Mr. RITCHIE. June 25, 1948.

We eventually got an answer to that. On this tightness to the grid, it might be interesting to know how we arrived at that. We made observations on shedding. Then Dr. Randall would set the plates in lucite and cut them in two and then polish the ends of them and study the ends under the microscope to determine that we didn't have this insulation around the grid. And that work had all been done prior to writing these letters.

Should I make these a part of the record, Senator?

The CHAIRMAN. That will be made a part of the record.

Mr. RITCHIE. Thank you, Mr. Chairman.

(The letter referred to above is as follows:)

RANDALL AND SONS,
CHEMICAL AND CHEMICAL ENGIEERING CONSULTATION,
2512 Etna Street, Berkeley 4, Calif.,
June 25, 1948.

Subject: Protecto-Charge.

Dr. GEORGE W. VINAL,
National Bureau of Standards, Washington 25, D. C.

DEAR DR. VINAL: I have had no reply to my former letter as yet. I have since developed a "Test for Storage Battery Additives," copy of which is enclosed, which gives a very severe test for these additives.

We find most striking results if we select a shelf sulfated or used battery that has been discarded because of failure to take a charge, but which is still in sound mechanical condition. The time to failure is much shorter than with a new battery, comparative results are obtained more quickly, and the treatment is most often recommended for such sulfated batteries.

When a sulfated cell is left untreated, it often reverses during the test, and it is difficult to obtain a full 300 ampere discharge on the breakdown. If one of the cells is untreated, a second treated with already known additives, e. g., mixtures of Glauber's and epsom salts, and the third with Protecto-Charge there may not at first appear to be more than a slightly favorable effect for Protecto-Charge, but shedding soon becomes evident with epsom salt treatments. On the prolonged overcharge the epsom salt treatment will fail much sooner than with the Protecto-Charge probably because of the much smaller bubbles evolved at the surface of the active material with Protecto-Charge as compared with the larger bubbles mostly in the vicinity of the grid bars with epsom. Of course, all this time, the untreated cell is out of the picture, as it will not ordinarily gain sufficient capacity, and the violent discharges and reversals will result in rapid further deterioration.

With kindest personal regards, I am,

Yours very truly,

MERLE RANDALL.

Senator FERGUSON. Mr. Chairman, may I ask a question?

The CHAIRMAN. Senator Ferguson.

Senator FERGUSON. Is what Randall is saying there that these people who are using this stuff find results from it?

Mr. RITCHIE. Yes, sir. What he is saying there is that these people who used this material—Permanente Cement is one he mentioned—had a battery cost of some $1,800 before on the same number of pieces of equipment on the same run, and the year after we treated these batteries, they had a battery cost of some $900 and something; in other words, we just cut it in two.

Senator FERGUSON. Has anybody, a customer, come in and claimed that your product is not any good?

Mr. RITCHIE. No, sir.

Senator FERGUSON. Do you know of anybody who used it——

Mr. RITCHIE. No, sir; I know of no one. I have talked with the National Better Business Bureau, and I have their statement in writing that they never have had a complaint there; they never had a complaint. Our local better business bureaus have never had a complaint either in Oakland or San Francisco.

Senator FERGUSON. Do I understand your complaints come from the Bureau of Standards, and the National Better Business Bureau?

Mr. RITCHIE. And that is all.

Senator FERGUSON. What about the manufacturers of batteries?

Mr. RITCHIE. Well, they are not too happy sometimes, but I have a neighbor who is the largest independent manufacturer on the west

coast, that is Hobbs Battery, and who, I understand, gave an interview to Chemical Week a while back, and said they always went along with the Association of Battery Manufacturers. They are just five blocks from me. I do not know them personally, though. They said they had never heard anything bad about the material.

Senator FERGUSON. They have made some objection, too, have they, the manufacturers of batteries?

Mr. RITCHIE. No, sir; other than send out these documents.

Senator FERGUSON. Send out the documents of the better business bureau and the Bureau of Standards?

Mr. RITCHIE. Bureau of Standards.

Senator FERGUSON. So your two complaints——

Mr. RITCHIE. Are the National Better Business Bureau and the National Bureau of Standards; that is all.

Senator FERGUSON. And a fraud order from the Department of the Post Office?

Mr. RITCHIE. Well, that was through the Bureau of Standards.

Senator FERGUSON. Yes.

Mr. RITCHIE. They did not have a user complaint, as I understand it. I went through the docket from stem to stern, and I cannot find any complaint in there from anyone.

Senator FERGUSON. They did issue a fraud order against you?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON. Without a complaint being made?

Mr. RITCHIE. Yes, sir; except from the Bureau of Standards.

Senator FERGUSON. Except from the Bureau of Standards.

Mr. RITCHIE. There is no complaint in the docket any place, except from the Bureau of Standards and the Post Office.

Senator FERGUSON. You say that the military authorities have used it?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON. Have any of them complained?

Mr. RITCHIE. Yes, sir; that they couldn't get any more of it.

Senator FERGUSON. Have they complained it would not work?

Mr. RITCHIE. No, sir; except Government laboratories, and they never have complained directly to me.

Senator FERGUSON. Government laboratories?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON. Is that the Bureau of Standards?

Mr. RITCHIE. Well, the Bureau of Standards, the Bureau of Ships, Ordnance Laboratories, the Signal Corps Laboratories.

Senator FERGUSON. What do they say?

Mr. RITCHIE. Well, the Signal Corps Laboratories, for instance, put in a Battery Compounds and Solution in their test report in which quoting the National Bureau of Standards through the National Better Business Bureau, they say all battery additives are no good.

Senator FERGUSON. Do all the services, the actual operators—they do not complain, but the so-called testers complain?

Mr. RITCHIE. The laboratories.

Senator FERGUSON. The laboratories.

Mr. RITCHIE. For instance, at Benicia Arsenal, we salvaged, I believe, around 2,500 batteries from the Pacific. They were out in the junkyard, and some of those batteries, believe it or not—it was done in the latter part of 1947 or the early part of 1948—are still going, a

few of them. They all have given a year's service or better. Those fellows were stopped from using the material to test the thing, and then when the test was completed, they still got orders not to discuss the thing or to use it.

Senator FERGUSON. Who made the first complaint against you to the Bureau of Standards?

Mr. RITCHIE. The Bureau of Standards, I believe, say they never have had a complaint.

Senator FERGUSON. How did they get into this picture?

Mr. RITCHIE. Through putting out Letter Circular 302, and by Dr. Randall writing to them.

Senator FERGUSON. These were praises rather than complaints of Randall's. Did they act on those?

Mr. RITCHIE. No; I never got an answer to them. That is the way Senators got into it. Some fellow asked how 24 Senators got tangled up in it. He said, "How did you get so much political pressure?"

Frankly, I never shook hands with my own Senator. The way we got action was the distributors wrote to the Senators, the Senators wrote to the Bureau of Standards, the Bureau of Standards wrote back to the Senators, and the Senators sent it back to their constituent, who was our distributor, and they sent it to us, and we could see how they were thinking. That is the way 24 Senators got tangled up in it.

The CHAIRMAN. You may proceed, Mr. Ritchie.

Mr. RITCHIE. To show that these salts have long been known to have a soluble effect on sulfate, and to show it also has been well known that they cause shedding in the battery, I would like to make this bulletin, Theory of the Storage Battery, by the General Lead Batteries Co., a part of the record.

The CHAIRMAN. That will be made a part of the record.

(The document above referred to is as follows:)

TECHNICAL BULLETIN

The Theory of the Storage Battery

GLB

TITAN
STORAGE
BATTERIES

GENERAL
LEAD BATTERIES COMPANY
CHAPEL STREET AND LISTER AVENUE
NEWARK, N.J.

NEW YORK
123 W 64th St.

CHICAGO
2814 Wentworth Avenue

Canadian Distributors
NORTHERN ELECTRIC CO.
Limited

Bulletin No. 28

Excerpt from page 3

It is true that the addition of such salts as Sodium Sulphate and Magnesium Sulphate, on account of their influence in increasing the solubility of Lead Sulphate, accelerates the oxidation of Lead Sulphate to Lead Peroxide. The presence of these additional salts, in a battery in regular operation, is detrimental because of the increased solubility above pointed out, and, therefore, these salts if used, must be very carefully removed before placing the battery in service. The amount of labor associated with these suggested processes is such as to make them impractical, excepting in the laboratory.

Pioneers Inc., Quoting Dr. Merle Randall
Professor Emeritus, University of California at Berkeley, California

"Battery AD-X2 is a specially prepared compound of chemicals containing sodium sulfate and magnesium sulfate which have been so treated that operating experience has shown the treatment to persist after its addition to the electrolyte of the lead-acid storage battery."

"DOES AD-X2 DO MORE THAN LESSEN "SULFATION"?
YES. AD-X2 assists the action by which the active material is kept in firm contact with the grid. The resistance of the battery, therefore, remains low and the porosity of the plates high.
Plates with the active material in firm contact with the grid, shed only to a slight degree."

Senator FERGUSON. Could I ask just one more question, Mr. Chairman?

The CHAIRMAN. Yes; you may.

Senator FERGUSON. Has any private testing firm, laboratory, other than the ones you have mentioned, ever condemned this product?

Mr. RITCHIE. No, sir.

The CHAIRMAN. You may proceed.

Senator HUMPHREY. Did you have a test by the Chicago Development Co.?

Mr. RITCHIE. Yes. Would you like to hear about that?

Senator HUMPHREY. No. Is that a private company?

Mr. RITCHIE. Yes, sir. I have the test. The tests are very good.

Senator HUMPHREY. Did you have any tests by the Signal Corps at the Signal Laboratory in New Jersey, of the shipyard—the Detroit Arsenal?

Mr. RITCHIE. May I answer them one at a time?

Senator HUMPHREY. Yes.

Mr. RITCHIE. The Signal Corps test—I do not have a copy of it because it was restricted—they ran a test such as, I believe, I have never seen, and then condemned the material, and then restricted the test, so I was never able to get my hands on a copy of it. I have known of the test, incidentally, and it includes a lot of tests. It includes the test from the Bureau of Ships Laboratories, which is very carefully done—of course, it has the specific gravities where the temperatures ought to be, and the temperatures where the specific gravities ought to be—but it is very carefully done, and they have a copy of the Battery Compounds and Solutions in it. It was widely distributed, and shut off all of the Government sales; but I was never given a copy of it.

The Chief of Ordnance test was run under the following conditions: They sent out orders to 5 arsenals to collect 50 batteries each. They took 10 batteries out of the junkyard, which had already been given a prolonged overcharge, they take them back and give them another prolonged overcharge, and I ask you to bear in mind that we say, "Do not first attempt to charge sulfated batteries, then treat; since charging prior to treatment deteriorates the grid in the positive plate." They didn't give those one overcharge, they gave them two prolonged overcharges.

They would not take the charge. They treated the batteries, they did take the charge. They put them out in service, 52 percent of them listed for 6 months, that is. I would have sworn you could never have gotten one of them out of the shop.

They treated a group of 50 operating batteries, they treated a group of 50 batteries on the shelf, supposedly new, and for controls they left 50 new batteries untreated.

In other words, you got four groups of batteries, and the only thing you got by way of control are 50 new batteries. The test ran for a period of 6 months, and then it was a restricted test, and we never could get our hands on a copy of it. Some of the fellows in on the running of the test had used thousands of treatments of this stuff, and they were flabbergasted by the way the test was laid out. But, for controls they used 50 news batteries.

Senator HUMPHREY. Mr. Chairman, I want to accept the testimony of Mr. Ritchie on this, but I submit that we ought to hear from the appropriate representatives of the different laboratories that made these

tests. I always find when Mr. Ritchie gets a test he did not seem to agree with, there is always something wrong with the testing method. I want to hear from the Detroit Arsenal and Navy Shipyard. The report numbers are not listed as being unavailable. They are available: the report for September 23, 1949, of the Detroit Arsenal, the report for February 23, 1949, of the Navy Shipyard, New York, and the report of May 23, 1949, from the Army Signal Corps. Those are three reports, and then the fourth report was the first Bureau of Standards report of June 29, 1949. I think we ought to at least have those made available to the committee.

The CHAIRMAN. I will say to Senator Humphrey that such is the intention of this committee. As the chairman of this committee, I wish to assure you that we will get all the facts into the record that we can possibly find, because this is a question that should be cleared up not only from the standpoint of the Government agencies, but of Mr. Ritchie, as a businessman. We will endeavor to obtain all the facts and all the information, and that is the only purpose of this hearing.

You may proceed, Mr. Ritchie.

Mr. RITCHIE. Thank you, Mr. Chairman.

On July 7 of 1948, we got the following wire from Western Ocean division of the United States Army engineers:

Reference your teletype WODKE 4385 and reference your letter WODVW 20 February 1948 Subject "Treatment of Storage Batteries." Contractors report of results obtained from use of "Protecto-Charge" as follows: A: 325 batteries treated. B: 320 were considered unserviceable. C: Inclusive dates of treatment, 1 March to 30 June 1948. D: 285 batteries reclaimed. E: 35 batteries did not respond to treatment.

These batteries were not opened.

F: Life expectancy of batteries treated, 3 to 5 months. Trial test on 5 new batteries with generator operating normal indicates increased period of service. Treated new batteries used 5 months show no evidence of plate disintegration or abnormal electrolytic reaction. Approximately 1,000 packages used. Life expectancy new untreated batteries. Guam. 120 days.

I would like to make that a part of the record.

The CHAIRMAN. That will be made a part of the record.

(The document referred to follows:)

TT WOGKC 5202
JULY 7, 1948.

From: DE Guam.
To: WOD.

Reference your teletype WODKE 4385 and reference your letter WODVW 20 February 1948 Subject "Treatment of Storage Batteries." Contractors report of results obtained from use of "Protecto Charge" as follows: A: 325 batteries treated. B: 320 were considered unserviceable. C: Inclusive dates of treatment, 1 March to 30 June 1948. D: 285 batteries reclaimed. E: 35 batteries did not respond to treatment. F: Life expectancy of batteries treated, 3 to 5 months. Trial test on 5 new batteries with generator operating normal indicates increased period of service. Treated new batteries used 5 months show no evidence of plate disintegration or abnormal electrolytic reaction. Approximately 1,000 packages used. Life expectancy new untreated batteries. Guam. 120 days.

Mr. RITCHIE. There is a situation I would like to mention here. In one of the group of tests that we sent back to the Bureau of Standards, the ammeter on the test instrument was off, and we didn't find that out until later, so it led to the belief that possibly we were claiming to increase the capacity of a battery over normal, which we do not

do; so, by the time we found out about it there had been a lot of confusion.

I would like to mention a patent at this point held by David N. Craig and George Wood Vinal, Bureau of Standards, on an electric heater for dry-cell batteries.

The CHAIRMAN. Do you wish that to be a part of the record?

Mr. RITCHIE. I don't believe so, Senator.

The CHAIRMAN. Then, what is the significance of it?

Mr. RITCHIE. All right; I will make it a part of the record.

The CHAIRMAN. Either give us a report on it or place it in the record.

Mr. RITCHIE. The thing is that the people who hold patents are normally opposed to each other in the same field; that is about the only significance to the patent.

The CHAIRMAN. Then you want that document to be made a part of the record?

Mr. RITCHIE. Yes, sir.

The CHAIRMAN. It will be inserted in the record.

(The document referred to is as follows:)

June 1, 1948. J. P. SCHRODT ET AL 2,442,380

METHOD AND SYSTEM FOR WARMING DRY BATTERIES

Filed Feb. 25, 1942

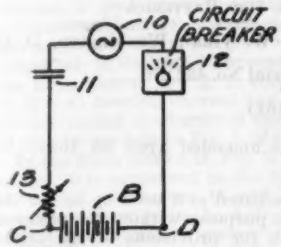

Fig. 1.

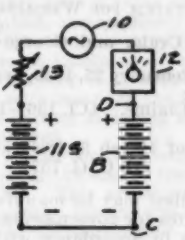

Fig. 2.

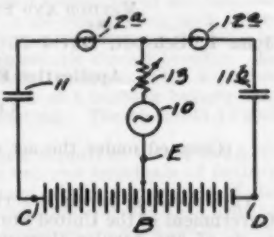

Fig. 3.

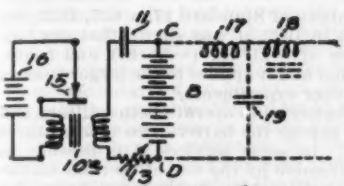

Fig. 4.

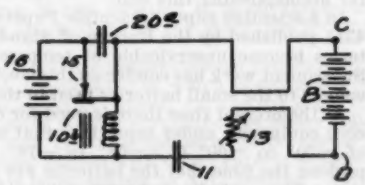

Fig. 5.

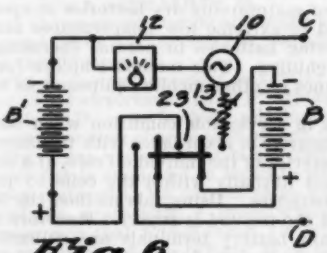

Fig. 6.

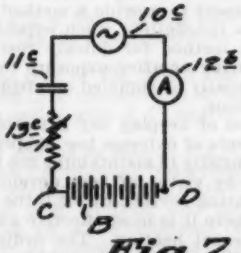

Fig. 7.

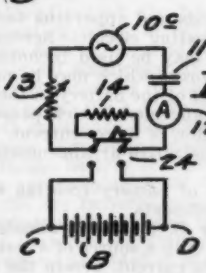

Fig. 8.

JOHN P. SCHRODT
DAVID N. CRAIG
GEORGE W. VINAL
INVENTORS

BY J. J. Mothershead

ATTORNEY

Patented June 1, 1948 2,442,380

UNITED STATES PATENT OFFICE

2,442,380

Method and System for Warming Dry Batteries

John P. Schrodt, David N. Craig, and George W. Vinal, Washington, D. C.

Application February 25, 1942, Serial No. 432,276

8 Claims. (Cl. 136—161)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention herein described may be manufactured and used by or for the Government of the United States for governmental purposes without the payment to us of any royalty thereon in accordance with the provisions of the act of April 30, 1928, (Ch. 460, 45 Stat. L. 467).

This invention relates to rendering batteries serviceable when subjected to extreme low temperature, and aims generally to provide method and apparatus for accomplishing this end.

In a scientific paper (Scientific Papers, Bureau of Standard 17, p. 627, 1922, No. 434) published by the Bureau of Standards in 1922, it was shown that dry batteries become unservicable at temperatures of —21° C. (—6° F.) and below. Subsequent work has confirmed this conclusion and it applies to the larger sizes as well as to the small batteries used in the earlier experiments.

At the present time there is need for dry batteries to operate both military and civil equipment under conditions that may expose the batteries to temperatures of —50° to —60° C. (—58° to —76° F.). In some services it is possible to prolong the time that the batteries are serviceable by the use of thermal insulation. This expedient does not provide a satisfactory method for protecting the batteries during long exposure, nor does it provide for restoring batteries to a serviceable operating temperature. It is the purpose of this invention in its method aspect to provide a method of maintaining dry batteries at operating temperatures indefinitely when exposed to extreme low temperatures and also to provide a method for quickly restoring batteries to normal operating temperatures during or after exposure to chilling. This method employs facilities which can usually be supplied on airplanes or other mobile equipment as well as at base stations.

The method of keeping dry batteries in serviceable condition when they are in environments of extreme low temperatures, in accordance with this invention, consists essentially in maintaining the interior of the individual cells at a suitable temperature by virtue of heat developed iternally within the cells by passage of an alternating current through the batteries. Using this method the heat is developed where it is most effective and the method is superior therefore to any form of external heating. The ordinary battery terminals are utilizable for the A.-C. heating circuit and no change in the design of the battery or its assembly need be made.

The invention further contemplates methods and apparatus for blocking discharge of the batteries through the A.-C. heating circuit. Several methods of so blocking the discharge of the batteries may be used including the use of (*a*) condensers, (*b*) counter electromotive forces which may be provided either by an external battery or by opposing one half of the battery to the other half or (*c*) by the use of any automatic circuit arrangement which passes alternating current while at the same time impeding the flow of direct current.

In the accompanying drawing showing illustrative arrangements according to and for practicing the invention:

Fig. 1 is a diagram of one embodiment of battery treating circuit; while Figs. 2 to 8 are diagrams of modified embodiments.

In the form shown in Fig. 1, the battery B, having terminals C and D, is connected for A.-C. internal heating in series with a source of alternating current 10 and means for blocking the flow of direct current, herein the condenser 11. Any source of A.-C. current may be used, such as an ordinary 110 v.-60 cycle line; a local transformer; an induction coil; and A.-C. generator, wind driven or otherwise; and the condenser 11 may be the smaller, the higher the frequency of the source 10. As an additional feature, if desired, an overload circuit breaker

12, preferably adjustable as shown, may be included to open the A.-C. heating circuit when the internal resistance of battery B to alternating current falls off to the value indicating the attainment of room temperature or a desired slightly higher temperature. In addition, if desired, the circuit may include a fixed, changeable, or variable resistance 13 to limit the A.-C. current flow. Such resistor, if used, should preferably have a value small compared to the internal resistance of battery B when chilled, and relatively large compared to such internal resistance when warmed. The voltage drop across the resistor 13 may be connected, if desired, to operate an indicator or automatic circuit breaker. In the form shown in Fig. 2, the battery B is connected in series with a source 10 of A.-C. heating current and with means in the form of a bucking battery 11*a*, for preventing discharge of the battery B during heating. The elements 12 and 13 may be used as in Fig. 1, if desired.

In the form shown in Fig. 3, the battery B is center tapped at E and the A.-C. source 10 is connected to the center tap and to the two end terminals of battery B through condensers 11 and 11*b*. This arrangement of the two halves of the battery in parallel in the A.-C. supply, reduces the resistance in the A.-C. heating circuit and therefore increases the heating current, as compared with the arrangement of Fig. 1, in which all the internal resistance of the battery is in series with the A.-C. source. Automatic circuit breaking means, shown as fuses 12*a*, 12*a*, and the limiting resistor 13, may be used if desired, in this as in any of the other forms shown. The use of two fuses 12*a* in the relation shown, instead of a single fuse in the lead between the source 10 and terminal E, is advantageous to insure full heating of both halves of the battery in the event the heating of one half lags with respect to the other.

In the form shown in Fig. 4, the battery B is connected through condenser 11 to the secondary of an induction coil 10*a*, the primary of which is connected in series with a suitable interrupter 15 and a source of current, such as dry cells, 16. This figure also shows in dotted lines, a filter circuit, exemplified by choke coils 17, 18 and bypass condenser 19, which may be connected between the battery terminals C and D and any load it is desired to feed with direct current stripped of A.-C. components, while the battery B is being subject to A.-C. heating. Such an arrangement might be used where the batteries had to be left permanently in circuit in a cold environment, but could be visited at frequent intervals with a heating set or a warm battery 16.

Fig. 5 shows an arrangement similar to Fig. 4, but using an auto-transformer-, or buzzer-type of A.-C. source 10*b*, and showing the usual condenser 20*a* connected across the interrupter.

In Fig. 6, the arrangement is similar to that of Fig. 2, but the battery to be treated is in two sections B and B', arranged to be connected in series with battery terminals C, D, or in bucking relation in series with A.-C. source 10, by means of the two-position change-over switch 23.

In Fig. 7, the arrangement is generally similar to that in Fig. 1, but an A.-C. ammeter 12*b* is employed to indicate when the internal resistance of battery B has been restored to its normal value by internal heating. Here the A-C source 10*c* delivers, preferably, a predetermined A.-C. voltage, and the resistor 13*c* is chosen such that $Rc+R_{BN}=K$ (in which Rc is the resistance of 13*c* and R_{BN} is the resistance of the battery B at normal temperature, say 25° C). While theoretically it may be desirable to choose the condenser 11*c* such that $(C_{11}\times C_{BN})/(C_{11}+C_{BN})=k$ (in which C_{11} is the capacity of condenser 11 and C_{BN} the internal capacity, at normal temperature, of the battery acting as a condenser) this does not seem to be a necessity.

From a practical standpoint, it has been found that while the 60 cycle A.-C. and the D.-C. resistances of the dry batteries, as measured by high-grade meters are not exactly equal, the A.-C. values being somewhat less than the corresponding values of D.-C. resistance calculated from flash currents, both the A.-C. and the D.-C. resistances increase in substantially the same ratio when the temperature of the cells in the battery is decreased from customary room temperatures to temperatures approaching −50° C. (−58° F.). This fact indicates that the behavior of the dry batteries subjected to the method of A.-C. heating can be considered substantially on the basis of their changing resistance with temperature and that the selection of a condenser to block the discharge of the cells is not critical provided it is capable of passing A.-C. currents of sufficient magnitude to produce the desired effect. With this arrangement heating of the battery to its normal operating temperature may be indicated by the obtaining of a predetermined reading of the ammeter 12*b*. In this form the resistance 13*c* may be termed a complementary resistance, and, as in the case of Fig. 1, will

preferably have a value within the range of warm and cold A.-C. internal resistances of the battery B.

In Fig. 8 the arrangement is again similar to Fig. 1, and again employs an A.-C. ammeter 12*b* to indicate completion of internal heating of battery B, but here a check impedance 14 is provided substitutable for battery B, as by the double pole double throw switch 24. Here again resistance 13 will preferably have a value between the cold and warm values of internal resistance of the battery, and impedance 14 will have a value equal to the effective impedance of the battery B at 25° C. Thus, with this arrangement one may select the proper impedance 14 and condenser 11*c* or a relatively large value of condenser, and determine the reading of ammeter 12*b* for these values; then throw switch 24 and heat battery B until 12*b* has the same value; and then throw switch 24 back and forth to check the equality of the battery impedance with that of impedance 14. As before the resistance 13 may be used or omitted, its use being preferred to limit the A.-C. current toward the end of the battery heating operation.

Considerable latitude in applying the alternating current is possible. It is not necessary that the voltage of the alternating current supply should equal or exceed the battery voltage. It may be materially less. The wave form of the A.-C. is immaterial. Even the distorted wave form produced by a mechanical interrupter is permissible. Commercial frequencies can readily be used, but higher frequencies are advantageous in permitting smaller condensers to be employed. If commercial power is not available, the alternating current may be supplied by small portable generators of various types.

If the voltage of the alternating current remains practically constant the current through the battery depends substantially entirely on its indicated internal impedance, which in the absence of an intervening discharge, is a function of its temperature. This provides a method of judging and controlling the internal temperature of the battery and its performance. Batteries which are provided with thermal insulation require less alternating current than those without, to keep them in satisfactory operating condition.

The operation of dry batteries in low temperature environments may be accomplished by either of two methods, as is apparent from the above: (1) the supply of a small alternating current continuously to keep the battery active and (2) the supply of a larger current for periods of a few seconds or a few minutes to restore the battery to a serviceable condition. The effectiveness of these methods in maintaining satisfactory battery performance in low temperature environments is illustrated by the results given in the following tables:

Table 1 compares the performance of two similar minature 45 volt B batteries, labeled "Burgess Y-30" and each comprising 30 tubular MnO_2-Zn cells, with the zinc shells ¼" D by ⅝" high, about ⅜" of which height contacts the electrolyte, in an environment of —50 to —60° C. (—58 to —76° F.). The battery designated as No. 1 was not supplied with A.-C. heat. It became unserviceable in about 25 minutes. Battery No. 2, on the other hand, was supplied with an alternating current of about ¼ ampere. Tests made at frequent intervals showed that it maintained satisfactory closed-circuit voltage and flash current throughout the test period of 2½ hours. Except for the initial values at 0 time each voltage and flash current entry in the table is a measured value following discharge of the battery for two minutes through 10,000 ohm resistance. This program of discharges was the subject of investigation at the time but for the purpose of establishing the beneficial effects of the alternating heating current any other program with or without discharges might equally well have been employed.

Table 1

Elapsed time	Battery No. 1 without heating			Battery No. 2 with A.-C. heating			
	External temperature	Voltage [2]	Flash current	Heat supplied		Voltage [2]	Flash current
				Time [1]	Current		
	° C.	*Volts*	*Amperes*	*Minutes*	*Amperes*	*Volts*	*Amperes*
0 minutes	+25	42.9				43.5	
2 minutes	+25	41.7	0.260			42.5	0.380
3 minutes	−50		(Both batteries placed in air at −50° C.)				
	−50			12	0.23		
17 minutes	−50	32.7	0.042			40.7	0.248
	−50			13	0.25		
27 minutes	−50	26.4	0.018				
32 minutes	−50					40.5	0.253
	−50			13	0.32		
42 minutes	−50	9.8	0.002				
47 minutes	−50	(Discontinued)				41.4	0.325
	−50			13	0.24		
62 minutes	−50					40.1	0.248
	−58			28	0.31		
92 minutes	−58					40.5	0.288
	−59			58	0.27		
152 minutes	−59					40.3	0.272

[1] The A.-C. heating was cut off 2 minutes before readings reported for battery No. 2.
[2] Closed circuit voltage after 2 minutes discharge through 10,000 ohms except initial closed circuit voltage readings at zero time.

Table 2 shows the effect of varying the A.-C. heating current on a small dry battery which was exposed to a temperature of −60° C. (−76° F.). This battery was provided with thermal insulation, but the battery became unserviceable, nevertheless, in about 2 hours when no A.-C. heating was supplied. The same battery, however, maintained reasonable serviceability throughout a test period of 6 hours when heating currents of 0.10 to 0.20 ampere were supplied. By interpolation it is found that a current of 0.22 ampere would maintain the battery at full operating efficiency equal to its performance at room temperature, 28° C. (82° F.). The battery dealt with in Table 2 was a "Minimax" 125 volt "B" and "C" battery comprising 81 flat type dry cells having zinc plates about 1" x ⅝":

Table 2

A.-C. heating applied	Percentage of Flash Current at 28° C. at–					Remarks
	1 hour	2 hours	3 hours	4 hours	6 hours	
0.00 ampere	46	8	0			
0.10 ampere	64	45	40	35	34	
0.15 ampere	79	70	68	66	66	
0.20 ampere	97	95	94	92	91	
0.22 ampere	100	100	100	100	100	by interpolation.
0.25 ampere	109	115	117	118	117	

Table 3 illustrates the possibility of restoring a dry battery which has become unserviceable because of low temperature conditions. For each of the experiments, the battery used was a single "penlight" cell (size AA) namely "Eveready" #915–1.5v, 17/32" D x 1⅞" height, and was initially at a temperature below −18° C. (0° F.). The condition of the battery is indicated by the low flash currents reported in the first column of the table. In this condition its internal resistance is high and 110 volts A.-C. was applied to the battery terminals. Using the last experiment reported in the table as an illustration, the A.-C. current through the battery increased slowly, requiring 230 seconds to reach a value of 1 ampere. Following this the A.-C. current increased rapidly, requiring only 27 seconds to reach 3.2 amperes at which time the A.-C. current was terminated. It is characteristic of all the experiments with these AA-cells that when the A.-C. current increased to about one ampere, the time required for a further increase to 3.2 amperes is about 25 seconds irrespective of the previous condition of the battery. The time necessary to restore a chilled battery to a serviceable

condition will depend on the initial condition of the battery and the available A.-C. voltage. The experiments show that in the worst case reported in the table the battery can be completely restored in about 250 seconds, but for others the time may be as short as 27 seconds. The indications are that unless the actual battery temperature is below —25° C. (—13° F.) the battery can be restored to serviceable condition in about 1 minute or less.

Table 3

Flash current as an indication of the condition of the battery	110-volt A.-C. heating applied [1]				Resulting flash current	Remarks
	Current (A.-C.) at—		Time			
	Start	Finish	To 1 amp.	Total time		
Amperes	*Amperes*	*Amperes*	*Seconds*	*Seconds*	*Amperes*	
1.25						Initial condition at 28° C.
0.205	0.7	3.2	4	27	0.95	Battery chilled to successively lower temperatures.
0.125	0.5	3.2	10	36	1.06	
0.090	0.2	3.0	20	42	0.93	
0.060	0.2	3.2	25	50	1.02	
0.044	0.2	3.2	32	58	0.98	
0.029	0.2	3.0	65	90	0.93	
0.019	0.2	3.2	67	95	0.97	
0.012	0.2	3.2	230	257	0.96	

[1] When the alternating current is first applied, the resistance of the chilled battery is high. The heating current is consequently small, but builds up to 1 ampere in the time shown in column 4, the rate depending on the previous temperature of the battery. After this current increases rapidly reaching about 3.2 amperes in an average time of 25 seconds regardless of the previous temperature of the battery.

From the foregoing detailed descriptions exemplifying our invention, it is apparent that the invention is not limited to any particular size or character of battery or to the particular embodiments of method and apparatus described.

We claim as our invention:

1. A method of raising the temperature of a pair of batteries to render them serviceable in environments of extreme low temperature, which consists in connecting the two batteries in voltage opposition to one another and passing an alternating current through the two batteries in series.

2. A method of raising the temperature of a center tapped battery to render it serviceable in environments of extreme low temperature, which consists in connecting the two ends of the battery to condensers and passing an alternating current through the condensers and the two halves of the battery in parallel with a return to the center tap of the battery.

3. A method of raising the temperature of a battery to render it serviceable in an environment of extreme low temperature, which consists in connecting a condenser in series with the battery and internally heating the battery by passing an alternating current through the battery and condenser to develop a substantial heating effect internally of the battery.

4. A system for warming batteries to render them serviceable in cold environments, consisting of a circuit for internally heating such batteries comprising a source of alternating current, means for connecting said source to the battery to be heated, and means for blocking any substantial discharge of said battery through said heating circuit comprising a condenser in series with said connecting means.

5. A system for warming batteries to render them serviceable in cold environments, consisting of a circuit for internally heating such batteries comprising a source of alternating current, means for connecting said source to the battery to be heated, and means for blocking any substantial discharge of said battery through said heating circuit comprising a potential source connected in said connecting means substantially equal and opposite to the potential of the battery to be heated.

6. A system for warming batteries to render them serviceable in cold environments, consisting of a circuit for internally heating such batteries comprising a source of alternating current, means for connecting said source to the battery to be heated, and means for blocking any substantial discharge of said battery

through said heating circuit comprising a second battery to be heated similar to and connected in voltage opposition to the first named battery.

7. A system for warming batteries to render them serviceable in cold environments, consisting of a circuit for internally heating such batteries comprising a source of alternating current, means for connecting said source to the battery to be heated, means for blocking any substantial discharge of said battery through said heating circuit, and a limiting resistance in series with said connecting means having a value between those equivalent to the chilled and warmed internal resistances of the battery to be heated.

8. A system for warming center tapped batteries to render them serviceable in environments of extreme low temperature, consisting of a circuit for internally heating such batteries comprising a source of alternating current, means for connecting one side of said source to a center tap on said battery, and connections, each including a condenser, for connecting the other side of said source to the respective end terminals of said battery.

JOHN P. SCHRODT.
DAVID N. CRAIG.
GEORGE W. VINAL.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
982,493	Hickley	Jan. 24, 1911
1,266,780	Edison	May 21, 1918
1,650,470	Salles	Nov. 22, 1927
1,974,187	Malpass	Sept. 18, 1934
2,157,139	Mirick	May 9, 1939

FOREIGN PATENTS

Number	Country	Date
26,688	Great Britain	1905

OTHER REFERENCES

Vinal, G. W., Storage Batteries, 2nd Ed. (1930), Page 269.

Mr. RITCHIE. Here is a letter of November 26, 1948, to me from the Oakland Better Business Bureau reporting on an investigation that they had made of our personnel and our product. I would like to make that a part of the record.

The CHAIRMAN. What is the content of the communication?

Mr. RITCHIE. The manager of our better business bureau died, and these battery dopes were quite prevalent and quite the thing. A boy came in from Chicago to manage the place, and I asked him to make a complete investigation of us himself personally, and to give me a report on what he found out, and this is it.

Incidentally, we are members of both the Oakland and San Francisco Better Business Bureaus, and I have been for a number of years. What we found out was that he was glad that he had made the investigation to eliminate any doubts, and in the meantime the bureau can only give a factual report on our company and product, which report, in the absence of information to the contrary, was favorable.

We never made an advertising claim without having the Oakland Better Business Bureau go over it. We never put out any type of advertising without sitting down and going over it with them.

The CHAIRMAN. That document likewise will be made a part of the record.

(The document referred to is as follows:)

BETTER BUSINESS BUREAU OF METROPOLITAN OAKLAND, INC.,
Oakland, Calif., November 26, 1948.

Re AD–X2 (Protecto-Charge).

Mr. JESS M. RITCHIE,
Pioneers, Inc., 2411 Grove Street, Oakland 12, Calif.

DEAR MR. RITCHIE: I am pleased to hear that you are taking steps to clarify the position of Pioneers, Inc., with regard to the nature of its product.

The Better Business Bureau of Metropolitan Oakland has never received complaints of any nature concerning your company. This applies to your product, personnel, or means of doing business. The only criticism which has existed in this office arose through a difference of opinion between the former manager and myself as to the use of the Better Business Bureau in your advertising. Your cooperation in complying with my suggestions in this respect has been completely satisfactory.

Investigation conducted by this office up to and including this date has revealed no information contrary to claims made by you, and while some phases of the investigation are still underway, we have no reason to believe that they will be negative. Our investigation has included a chemical analysis, correspondence, and conversation with users of the product and considerable questioning of you and requests for information from you.

Information received by the Better Business Bureau from the Bureau of Standards indicates that the Bureau of Standards has not tested your product and have categorically classified it as a battery dope. At the present time we are endeavoring to obtain from the Bureau of Standards a full report on your product, including a comparative analysis between the findings of Kenneth Bonnickson's chemical analysis and that of the Bureau of Standards. To facilitate this action, we are sending the Bureau of Standards a sample of your product that they may make the necessary examination.

Like you, I am anxious to eliminate any doubts which may exist as to the validity of your claims and the actual merit of your product.

Thank you for your cooperation in the past. We shall keep you advised of our future findings.

In the meantime, this Bureau can only give a factual report on your company and product, which report, in the absence of information to the contrary, is favorable.

Sincerely yours,

JACK A. HARRIS,
General Manager.

JAH: mc.

Mr. RITCHIE. By this time, the general manager of the Oakland Better Business Bureau had reached a conclusion that possibly there was some confusion, and he wrote the director of the Electrochemistry Division of the National Bureau of Standards and told him about his findings, and asked them if there was anything they could do to clear it up. I would like to make that a part of the record.

The CHAIRMAN. What is the reply?

Mr. RITCHIE. From the Bureau of Standards?

The CHAIRMAN. Yes, sir. What is the date of your letter?

Mr. RITCHIE. The date of the better business bureau letter was December 1, 1948.

The CHAIRMAN. And the reply was what date?

Mr. RITCHIE. The reply was dated December 22, 1948.

(The better business bureau letter dated December 1, 1948, is as follows:)

BETTER BUSINESS BUREAU OF METROPOLITAN OAKLAND, INC.,
Oakland, Calif., December 1, 1948.

Re AD–X2 (Protecto-Charge).

Dr. GEO. W. VINAL,
Chief, Electrochemistry Division,
National Bureau of Standards,
Washington, D. C.

DEAR DR. VINAL: I am writing you because I am most anxious to determine the facts concerning the product known as AD–X2 and formerly known as Protecto-Charge.

The manufacturer of this product, Jess M. Ritchie, doing business under the trade style Pioneer, Inc., 2411 Grove Street, Oakland, California, is and has been a member of this Better Business Bureau for over one year. My personal experience with Mr. Ritchie is such as to lead me to believe that his personal integrity is high. Mr. Ritchie and Pioneer, Inc., are presently manufacturing and selling AD–X2 as a compound to reduce the harmful effect of sulphation.

The attached literature explains in some details the claims of the product. My investigation of the product and its results are based upon chemical analyses, sample testings in batteries, and conversations with regular users of the product who have made extensive tests of its effectiveness and make vigorous claims on behalf of the product's success.

Apparently established laboratories have found that this product is neither Epsom Salts or Glauber's salts and contains no acid or other elements known to be harmful to lead-acid type storage batteries.

As a result of the confusion which has existed in the battery industry for a number of years by the promotion of battery "dopes," this product has become generally classed by many as a 'dope." I am writing, therefore, to ask that you, through your office, initiate a test similar to the one reported on in the attached (see letter dated August 26, 1948, Kenneth Bonnickson to Pioneers, Inc.).

In this way it will be possible for us to have the expert opinion of the Bureau of Standards and that we may then determine whether or not this product can justly be sold as a nonharmful product to aid in lengthening the life of storage batteries.

Your cooperation in this respect will be most helpful.

Sincerely yours,

BETTER BUSINESS BUREAU
OF METROPOLITAN OAKLAND, INC.,
JACK A. HARRIS, *General Manager.*

JAH:nh

Mr. RITCHIE. Should I read a portion of the reply?

The CHAIRMAN. That is from the Bureau of Standards?

Mr. RITCHIE. Right.

The CHAIRMAN. From a person within the Bureau of Standards?

Mr. RITCHIE. Right.

The CHAIRMAN. In an official capacity?

Mr. RITCHIE. Right.

The CHAIRMAN. Read the contents of it.

Mr. RITCHIE (reading):

I received your letter of December 1 with reference to a product called AD–X2 (Protecto-Charge). During the past 25 years several hundred materials alleged to improve the performance of storage batteries have appeared. Some of these have been tested at this Bureau. Many of these materials have contained magnesium sulfate and sodium sulfate. These substances with the required amount of water of hydration are commonly known as epsom salt and glauber's salt. These materials have not been found beneficial in the operation of storage batteries, and we so reported in our Letter Circular No. 302 which has been widely distributed.

Circular Letter No. 302 was distributed in 1931.

This Bureau has not made any tests of AD–X2 (Protecto-Charge), the main reason being that Dr. Merle Randall, who is connected with the company, informed us by letter on April 23, 1948, that Protecto-Charge involves the addition of a mixture of anyhdrous sodium sulfate and a slightly basic, nearly anhydrous magnesium sulfate to the water when it is filled with the standard sulfuric acid electrolyte. Epsom salt and glauber's salt differ from these substances only in having water of crystalization. When the dry salts are added to a water solution the result is essentially the same as if proportionately larger amounts of glauber's salt and epsom salt had been added. In the anhydrous state they are not called epsom salts and glauber's salt, but this is merely a matter of terminology.

We have been informed that tests of this material are being made at the Signal Corps Laboratory at Fort Monmouth, N. J., and at the New York and Mare Island Navy Yards. These are competent laboratories dealing with large numbers of batteries. In view of the above fact it does not seem desirable for a fourth Government agency, that is, this Bureau, to spend the time urgently needed for Army and Navy work to make further tests of these materials.

This Bureau does not make commercial tests of batteries or battery materials, and it is an established policy of the Bureau not to endorse commercial products or to permit the results of its tests to be used for advertising purposes.

The CHAIRMAN. Was this letter, Circular Letter 302A of the National Bureau of Standards, a publication for the public in general or was it a publication that was put out by the National Better Business Bureau? How did this 302 get publication? Did the Bureau of Standards send it out?

Mr. RITCHIE. The Bureau of Standards sent it out.

The CHAIRMAN. As a general, national publication?

Mr. RITCHIE. That is right; that is their direct instrument.

The CHAIRMAN. And they made that available to just anyone?

Mr. RITCHIE. Just anyone. You write in about a battery additive—we had it done by several people—and they always sent you 302.

The CHAIRMAN. Was this likewise published in any of the publications of the National Better Business Bureau?

Mr. RITCHIE. Yes, sir; it was reproduced in all their publications, and still is.

The CHAIRMAN. You may proceed.

Senator GILLETTE. Mr. Chairman——

The CHAIRMAN. Yes, Senator Gillette.

Senator GILLETTE. Who signed that letter you have just been reading?

Mr. RITCHIE. That letter is signed "George Wood Vinal, Chief, Electrochemistry Section, Division of Electricity and Optics."

Senator GILLETTE. Dated when?

Mr. RITCHIE. That is dated December 22, 1948.

Senator GILLETTE. That was after the date of the Randall letter to them which you say was not answered?

Mr. RITCHIE. The Randall letter to them, the first one, was on April 23, 1948. This is December 22, 1948.

Senator GILLETTE. And this was the first comment that you had from the Bureau of Standards relative to the Randall letter?

Mr. RITCHIE. No, Senator. I think I have 2—1 short letter here—that was the first explanation we had ever had. We had had short letters like this one of July 16.

The CHAIRMAN. What year?

Mr. RITCHIE. Of 1948.

Senator GILLETTE. In this letter from which you just read an excerpt, there was a statement made that it was not their policy to give endorsement of commercial products.

Mr. RITCHIE. Yes, sir.

Senator GILLETTE. Had you requested an endorsement?

Mr. RITCHIE. No, sir. We had not up to this point asked for a test or discussed a test, up to this time in 1948, December 22, 1948.

Senator GILLETTE. You did not read quite all of the letter, but, in addition to the statement that it was not their policy to issue endorsements of commercial products, was there any statement that it was not their policy to issue condemnatory statements on products?

Mr. RITCHIE. The rest of that letter is:

We have recently had some correspondence with the National Better Business Bureau in New York on the subject of revising and making more emphatic Letter Circular No. 302 which this Bureau issued some years ago regarding materials said to improve the performance of batteries. You may wish to contact the National Better Business Bureau in this connection at its headquarters in New York.

We are retaining the samples which you sent for further reference, if necessary.

The CHAIRMAN. Now you have read the full contents of the letter?

Mr. RITCHIE. That is the full contents of the letter.

Senator FERGUSON. Might I inquire there, you have been naming this 302?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON. That was issued in 1931 before your product was on the market?

Mr. RITCHIE. Yes, sir; the product was condemned about 16 or 17 years before it was developed.

Senator FERGUSON. A reprint of that was made—I just asked counsel—in 1949?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON. Was that before or after your product?

Mr. RITCHIE. That was after my product.

Senator FERGUSON. All right.

Now, up to that date had the Bureau of Standards ever tested your product?

Mr. RITCHIE. No, sir.

Senator FERGUSON. Then 504 was issued in January of 1951 as a statement from the Bureau of Standards?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON. Up to the date that they issued that, had your product ever been tested by the Bureau of Standards?

Mr. RITCHIE. Not to my knowledge; no, sir. I have never heard them claim they had made any attempt to test it up to 504 in 1951.

Senator FERGUSON. So then these prints, 302 and 504, were issued condemning all additives to batteries?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON. And they were made without testing your product?

Mr. RITCHIE. Five hundred four, I do believe now, it was for a long time—I didn't think it was included because there is no analysis in 504 that agrees with what we know AD–X2 to be, but I think that was tested when they printed 504.

The CHAIRMAN. You mean AD–X2 had been subjected to a test by the Bureau of Standards before 504 was made public as an official document of the Bureau?

Mr. RITCHIE. I think AD–X2 was included in the work of which 504 was a printing.

Senator FERGUSON. That was not my question. My question was: Prior to the issuance of 504, had the Bureau of Standards tested your product?

Mr. RITCHIE. No, sir.

Senator FERGUSON. But that 504, as well as 302, condemned all additives?

Mr. RITCHIE. Yes, sir.

Senator SMATHERS. Mr. Chairman, may I ask a question right there?

The CHAIRMAN. Yes.

Senator SMATHERS. Up until 1952, had the letters or the correspondence which you had had with the National Bureau of Standards—had you indicated anything else in your formula besides this epsom salts and this glauber salts; had you said that there was anything in addition to those two elements in it?

Mr. RITCHIE. I never said there were epsom and glauber salts in it, either; I never told them anything. I still haven't told them anything.

Senator SMATHERS. In other words, in the letter which they put out, 302, they were just, as I gather it, condemning additives of the nature which they thought that you had?

Mr. RITCHIE. I rather believe that is right.

Senator SMATHERS. You did not make any special claim, as I understand it, of any secret trace elements or anything of that nature when those letters came out; and isn't that why they did not make any investigation of it?

Mr. RITCHIE. We told them from the beginning, from Dr. Randall's first letter of April 23, 1948, that battery AD–X2 reacted differently than did sodium sulfate and magnesium sulfate.

Senator SMATHERS. Did Dr. Randall ever say in those early letters anything like a secret trace substance or element was included—did he say that in those letters that he wrote prior to 1952?

Mr. RITCHIE. No.

Senator SMATHERS. In other words, he, in effect, admitted it was the same element or they were the same elements, but it just had a different reaction?

Mr. RITCHIE. He told them that there was magnesium oxide in it.

Senator SMATHERS. Was magnesium oxide supposed to be something new in these additives?

Mr. RITCHIE. I never found it in any other additive. I don't know whether it had anything to do with our additive or not, but I never found it in any other additive.

Senator SMATHERS. And he wrote that in the letters which he wrote to the Bureau of Standards?

Mr. RITCHIE. He did, and he also said it was slightly basic, and epsom salts and glauber salts are not basic.

Senator SMATHERS. Even after he had written such letters, they at that time did not make any examination of it? When was the first examination made, test of this made, by the National Bureau of Standards?

Mr. RICHIE. I am a little confused on that issue. I rather believe that the work was probably done in 1949 or 1950, but it was not published until 1951.

The thing on 504—you can take a test like 504, and study the test—a battery is rather like a tree, it has its own history. For instance, I can look at that battery there, and I can tell you a lot of things about it. You can drill a hole through the growth rings of a tree, and you can tell a lot about a tree; and a battery is something awfully hard to cover up. The blamed thing is a tattletale so long as there is a piece of it left.

Senator SMATHERS. If that were true, how would the same formula have the same effect on every battery if every battery is different?

Mr. RITCHIE. It is just the different stages of its life; at different stages of life different things happen.

This battery here—the water has been down on it, you can tell it by white sulfation. If the crystals had formed under water it would have been a different color.

Senator SMATHERS. I do not know anything about batteries. I am just taking your statement that each battery was different. You knew something different about each battery by looking at it. How would this same formula have the same effect on each battery, even though you admit that each battery is different?

Mr. RITCHIE. Because each battery has sulfation in it or sulfate. In other words, you cannot discharge any battery without sulfating it, and you cannot keep the material fresh unless you keep it under constant charge which, in itself, might sulfate it. In other words, this combats sulfation which is present in all batteries at some stage, I believe.

But what I started to say about 504 was you can study 504 and you will find, (1) the samples weren't opened to determine what they had to start with; (2) they gave the batteries a prolonged overcharge before they treated them. The same thing had happened, I show——

The CHAIRMAN. But, Mr. Ritchie, what happens to a battery if you give it an overcharge? You understand we do not know anything about batteries. Therefore, we must rely on one of the simple everyday explanations, otherwise we cannot follow you.

What happens if a battery is overcharged?

Mr. RITCHIE. Well, in an overcharged battery, Senator, you get shedding in the negative plate, the active material——

The CHAIRMAN. In other words, it deteriorates the content and makes the contents of that lead cell slough off particles?

Mr. RITCHIE. Right.

The CHAIRMAN. And when too great a slough-off has taken place, the accumulation in the cell is such that it is built up and makes possible a contact underneath the plates, and you have a positive short in the battery, and it is dead.

Mr. RITCHIE. Right.

The CHAIRMAN. We all know what the serviceman tells us when we come in with a dead battery. He gives it a test and he says, "It is dead."

Mr. RITCHIE. Right.

The CHAIRMAN. And the next thing we do is ask, "How much will a new one cost, and how much will you allow me for my old one?" That is the calm and orderly expression of a man with a dead battery.

Mr. RITCHIE. That is right.

The CHAIRMAN. You are telling us that an overcharge will bring about the death of a battery in much less time than if a battery had not been subjected to an overcharge. Then, what does your compound do to neutralize or to overcome the overcharging? What does it do, in simple language that I can understand?

Mr. RITCHIE. Senator, this battery here has a rated capacity as a new battery. As that material becomes hard and insoluble, that capacity lessens and lessens, and you may get down to five amps in that battery.

All right. If the rest of that material is inert and you are charging at the normal rate on this battery of, say, 20 amps rate, on a hundred-amp cell—this is larger than a hundred-amp cell, but we will take it that you are charging a hundred amps into a 5-amp area—the rest of the battery is not taking any charge, so you are overcharging the portion taking the charge, and that causes the battery to mush up.

Now, the batteries that were used in 504 were stored wet for a number of years—you follow me—they had no capacity; so they give those batteries a prolonged overcharge, and the only thing that functions there is the grid, the only thing that reacts is the grid in the positive plate. It leaves the grid in the form of peroxide. Then you have what I have shown you was in the original cell, a sulfated plate with no grid.

The CHAIRMAN. You contend that the compound you had mixed has the tendency of keeping that battery cell from getting hot?

Mr. RITCHIE. Right.

The CHAIRMAN. You also contend that it has the tendency to neutralize the acid of the battery and thereby prevent an acid corrosion or an acid eat-up of the battery? Is that what you contend?

Mr. RITCHIE. No, sir.

The CHAIRMAN. Then I would like to have you go into it and give us a simple explanation of it.

Mr. RITCHIE. All right.

The acid in the battery, on treatment, remains the same. But it is the position of the acid that the additive has to do with.

If the battery is fully charged, the acid is out in the solution, it is out in the water, and, as it goes back into the plate on discharge, it becomes sulfated.

Then, when it is in the plates, sulfated, it ages; and the crystals that are formed by the lead and lead peroxide and the acid get hard.

The CHAIRMAN. What does your compound do that prevents that hardening of those crystals?

Mr. RITCHIE. These crystals, when they harden, become more perfect and less soluble to the charge. By putting this compound in you cause those crystals to form in a less perfect shape; instead of having a solid crystal that is hard to get to, you have a crystal that is fractured. These chemicals cause these crystals to be fractured, to be in smaller segments, so when you start charging you have got a greater area on which to work your oxygen and hydrogen again, so that these crystals are more easily soluble. Your acid content remains the same in the battery.

The CHAIRMAN. In other words, it keeps the crystals broken up into a finer body, and because it is finer it cannot seal itself in there.

Mr. RITCHIE. You have the picture, Senator.

The CHAIRMAN. All right. That is what I was trying to get. In other words, it has the effect of softening the crystal formation, just the same as you soften water by a certain chemical process; it has a tendency to keep these crystals in a soft form so that they do not seal up and destroy the usefulness of the battery.

Mr. RITCHIE. Well, the crystal may get hard, but it will have fractures in it; instead of having one large crystal, it will be a large crystal with, say, a group of cracks in it.

The CHAIRMAN. It no longer is acting as a resistor to thereby make possible the shorting of that segment of the cell?

Mr. RITCHIE. So that the energy that is passed has got a lot of small surfaces in this large crystal to work on instead of just the outside edges of the large crystal.

The CHAIRMAN. I can readily see that, to a man who has been servicing batteries for a number of years, this question is very simple; but, for us who have not been battery-service men and who do not know about the formation of the crystals, and so forth, that destroy the usefulness of a battery, it is necessary to explain it in the manner of A B C or we cannot follow you, sir.

Mr. RITCHIE. It was not easier for a cat skinner to learn, either, Senator; I mean it took me a long time to get some of these things.

The CHAIRMAN. That is all right, sir, but you are not demonstrating to us how to be a cat skinner.

Mr. RITCHIE. No, sir.

The CHAIRMAN. What we want here is to have it in simple terms so that we understand what your compound has been able to do.

Mr. RITCHIE. If this glass were a crystal and I wanted to get a lot of area on it—I am going to take the glass and let it be solid—we would hold the crystal in the same position by holding it in a rubber sock and taking a hammer and whamming it and breaking it into a number of pieces. That is the type of thing that happens.

The CHAIRMAN. You mean your chemical, in other words, has the effect of breaking up the crystal that is a natural process in a battery, as a battery gives off its energy, as it furnishes the power for the starter, and the lights for the car?

Mr. RITCHIE. Yes, sir.

The CHAIRMAN. In giving off, there is this formation of crystals and, ultimately and finally, it has the tendency of sulfating your battery.

Mr. RITCHIE. It has the tendency of hardening and resisting the charge. When it is first discharged, why, the material is very soft.

The CHAIRMAN. When a battery cell becomes too hard, it just simply falls off, then you can look down in a battery and you can see the framework of the honeycomb of that cell, but it has lost its segments between the honeycomb.

Mr. RITCHIE. That is right.

The CHAIRMAN. When those segments fall to the bottom, they absolutely short your battery.

Mr. RITCHIE. Right.

The CHAIRMAN. What you contend is that this product is like oil on the boot; it keeps the boot from deteriorating by becoming stiff.

Mr. RITCHIE. That is it exactly.

The CHAIRMAN. It keeps this battery from becoming stiff and the particles breaking and falling down to short the battery?

Mr. RITCHIE. Right.

The CHAIRMAN. Your compound acts like oil on a piece of leather, and it keeps it from getting hard and deteriorating in that manner.

Mr. RITCHIE. O. K.

Senator DUFF. In a word, doesn't it mean that you preserve the porousness instead of having it become dense?

Mr. RITCHIE. Yes, sir.

Senator DUFF. Isn't that what it does?

Mr. RITCHIE. That is exactly what it does.

Senator SMATHERS. Mr. Chairman, may I ask a question of the witness?

The CHAIRMAN. Senator Smathers.

Senator SMATHERS. Mr. Ritchie, who else knows how to make this formula besides yourself?

Mr. RITCHIE. A safety deposit vault in Oakland, Calif., and my vice president knows the mechanics of it; and I am insured.

Senator SMATHERS. What I am driving at is this: I would not want you to give your secrets away or anything like that, but do you make it up in gallon forms or do you make it up in 10-gallon forms, or how do you go about getting this formula made up?

Mr. RITCHIE. It is a powder. Here is a treatment package for a group 1 battery. One of these envelopes goes in each cell of a battery, and on larger batteries you have one envelope per quart of plate area cavity.

On this battery here, for instance, we only work on the plate area, so we have got 5 by 5—that would take 3 of these envelopes. This area in here is 3 quarts.

So you take three envelopes. If that were filled with water you just simply open it up, pour it in, and if the battery is on charge that would go right into solution.

Senator SMATHERS. Let me ask you this: Couldn't some chemist take that powder there and figure out everything that is in it? Wouldn't you think some pretty good chemist would be able to do that?

Mr. RITCHIE. Dr. Randall believed if you had 10 chemists 30 years, and they worked diligently at it, they might be able to crack it, but said just to keep my mouth shut and not to worry about it.

Senator SMATHERS. If 10 chemists could not get together and figure out what it was, how is it possible for you to keep putting that formula back together again?

Mr. RITCHIE. We have certain controls and if the material will not pass these controls when we are finished with it, why, we junk it.

Senator SMATHERS. In other words, then, on each batch of those powders which you make up you try them out and see whether or not they will work?

Mr. RITCHIE. We run them through these controls. If two things occur then we know we have this action; if they don't occur, then we dump the material.

Senator SMATHERS. Do you find that you change the formula very regularly—do you have to change, do you have to experiment with each new batch of powder which you make up in order to see that you get the same results?

Mr. RITCHIE. No, sir; we don't know enough about it to do that sort of thing. We do the same thing that we did when we hit it; every time we do that same thing. Then we run it through this control.

Senator SMATHERS. I do not know anything about chemistry at all. I took a high-school chemistry course and had a hard time passing it, but it is difficult for me to understand why expert chemists cannot figure out what you have here including trace elements. Why is it that they cannot find out what is in it? Apparently you yourself are not sure what is in it, or, if you are sure, you will not tell anybody, which is your prerogative. Do you actually know what is in this or is it that you suddenly had sensational results and you were not quite sure what it was all about?

Mr. RITCHIE. Senator, I don't know too much about what is in it.

Senator SMATHERS. How do you keep getting back to the same results if you do not know what is in it? What do you experiment with when you are trying to get the same results?

Mr. RITCHIE. I don't do any——

Senator SMATHERS. What do you use?

Mr. RITCHIE. I don't do any experiments. After we hit this thing we quit experimenting; we just do the same thing over and over. You take a piece of black crayon over there, and you keep on making a black mark, and you keep on making a black mark.

Senator SMATHERS. Would it not be a good idea to tell the Bureau of Standards exactly what you do so they can be satisfied that this is a good thing you are doing? They are honorable chemists, and if you have a formula which is made up of certain ingredients which they know is good or which they would be willing to try to demonstrate is good, why would it not be a good idea to tell them about it?

Mr. RITCHIE. I think they know as much about it as I do from the report in the Post Office case, and they found some things I knew were there, and some things I didn't know were there.

Senator SMATHERS. They found it was no good. As I understand it, you are saying just lately there is something different. Originally you said they discovered everything that was in it, and some things you didn't know were in it. So then, so far as the National Bureau of Standards is concerned, there is nothing secret, there is no secret ingredient, in here.

Mr. RITCHIE. Senator, I see you are wearing a ring that is made of gold. You can take it downtown and you can find a lot of chemists down there who can analyze it but I have never seen any one of them make any of it.

Senator SMATHERS. In other words, you are saying that you can take this same formula, the same ingredients—let us not get away from this one point for a minute. You will admit then there is no ingredient in this, other than what the National Bureau of Standards found in it when they testified in the Post Office case? In other words, you said they found everything that was in it, plus a few things you did not even know about.

Mr. RITCHIE. Right. I didn't say their proportions were right. I said they found it.

Senator SMATHERS. So there is then no special ingredient in there they do not know about.

Then it comes down to a question as to whether or not they have the right proportions; is that what you say?

Mr. RITCHIE. That would have a lot to do with it, because we are very careful about the proportions. I do not know—bear this in mind—I do not know whether it is the treatment we give this material that causes it to work as it does—I do not know whether it is the material that is in it that causes it to work as it does—I don't know whether it would work with some of the materials out of it or not, those things I don't know. All I know is that I do the same thing with the same materials repeatedly and get the same results. As for the Bureau of Standards' test, they ruined the batteries before they tested them.

Senator FERGUSON. Did they follow directions?

Mr. RITCHIE. No, sir.

The CHAIRMAN. What do you mean by the statement that the Bureau of Standards ruined the batteries before they tested them?

Mr. RITCHIE. Well, in 504 they take and give the sulfated batteries the prolonged overcharge before they put the powder in, and you can tell by the voltage readings and the hydrometer reading that the batteries were gone before they ever treated them. You could put anything in them, and it would not have had any effect.

The CHAIRMAN. If you put the battery in a car or the battery through its normal usage, the battery would have broken down?

Mr. RITCHIE. It would have been worthless.

The CHAIRMAN. Because of the overcharge?

Mr. RITCHIE. Right.

The CHAIRMAN. You mean they destroyed the cell segments?

Mr. RITCHIE. They destroyed the grid in the positive plate before they ever put the material in it at all.

Senator GILLETTE. You said you do not have this formula patented?

Mr. RITCHIE. Right.

Senator GILLETTE. Have you made an application for a patent?

Mr. RITCHIE. No, sir.

Senator GILLETTE. Is your formula in such shape that you cannot make an application for a patent?

Mr. RITCHIE. I believe we couldn't; no, Senator, because it has been in popular use for over a period of a year.

Senator GILLETTE. Then the only protection you have, as you have stated your case here, the only protection you have, is that the formula that you were using you are keeping secret.

Mr. RITCHIE. Yes, sir.

Senator GILLETTE. And that you do not anticipate that any analysis is going to crack your formula?

Mr. RITCHIE. No, sir; I don't.

Senator GILLETTE. You do not need the protection of a patent?

Mr. RITCHIE. That is right.

Senator GILLETTE. Was that the reason that you did not apply for a patent or was it because your formula was in such shape that you could not state it in an application for a patent?

Mr. RITCHIE. I rather think it was probably both of them. We knew what we had done; we knew what we had used, and we knew we could reproduce it. To describe it, I myself could not do it. I am sure of that, and whether Dr. Randall would have attempted it, I have some doubt.

We decided when we hit this thing—that was one of the decisions we made—that we would keep it a secret formula because, as Dr. Ran-

dall said, the way we arrived at it was not logical. In other words, if you started trying to figure the thing out it would not occur.

The CHAIRMAN. Mr. Ritchie, how many tests did you make before you finally settled on the product that you are using?

Mr. RITCHIE. There were over 1,600, Senator—I believe it was 1,627 or something like that; it was in the 1,620's.

Senator GILLETTE. May I ask just one other question?

The CHAIRMAN. Yes, indeed, you may.

Senator GILLETTE. The descriptive letters you use, AD–X2——

Mr. RITCHIE. "AD" is additive; "X" is the unknown portion of the thing; 1 ion of sodium and 1 ion of magnesium.

Senator GILLETTE. That trade name you are using, have you copyrighted that?

Mr. RITCHIE. We copyrighted it a long time ago; we have recently trademarked it.

Senator GILLETTE. I see. That is all, Mr. Chairman.

The CHAIRMAN. You may proceed, Mr. Ritchie.

Mr. RITCHIE. Here is a rather amazing letter to a businessman in Oakland from the Chief of the Electrochemistry Section. It is dated February 15, 1949:

> This is in reply to your letter of January 24 about a battery compound called Protecto-Charge or AD–X2. As you probably know, very many compounds have appeared within recent years which are said to improve the performance of batteries, but the Bureau's experience has indicated that they are ineffective although in many cases they may be harmless. We can give you no definite information in regard to the specific material about which you inquired. This Bureau does not endorse any of these compounds and we believe the matter was explained quite fully in our Letter Circular No. 302 to which you referred. Although this was issued some years ago, we believe that the statements which it contains are valid today.

It is signed by George Wood Vinal, Chief, Electrochemistry Section, Division of Electricity and Optics, National Bureau of Standards.

We have been corresponding with him now for 2 years, and he comes back and tells this man he cannot give him any information on a situation, but he thinks it is covered by Letter Circular 302, which was published in 1931.

The CHAIRMAN. Senator Ferguson must leave because the Senate has reconvened. You heard the bell a few minutes ago.

Senator SMATHERS. Mr. Chairman, I would like to leave, too; I have to go over to the floor.

The CHAIRMAN. We are sorry to have you gentlemen leave, but we will continue until such time as we are forced to recess because of a quorum call. We had hoped to have a meeting this afternoon, but there is a unanimous consent agreement to vote at 3 o'clock, and it is on a very important question and, therefore, we cannot sit this afternoon. But, for the information of all, we will resume at 10 o'clock tomorrow morning.

Now, you may proceed, Mr. Ritchie, and when we are forced to recess, we will.

Mr. RITCHIE. Thank you, sir. This is not going nearly so fast as I hoped it would.

Here is a scientific paper that Dr. Randall gave before the American Chemical Society at their spring meeting in San Francisco in 1949. I

would like to have it made a part of the record because I believe it will be of help in the discussion of exactly what it has.

The CHAIRMAN. It will be made a part of the record.

(The document referred to follows:)

AGING OF LEAD SULFATE IN THE LEAD-ACID STORAGE BATTERY

By Merle Randall, consultant, Randall and Sons, chemical and chemical engineering consultation, 2512 Etna Street, Berkeley 4, Calif.

Nearly everyone uses the lead-acid storage battery. It starts our automobile or tractor engine, it serves as a standby power for our telephone or exit light, it energizes our railway signals, it lights our trains, it powers our mine locomotives and works in silence in places high and low too numerous to mention. We might even say the storage battery has become indispensable to our modern way of life. As with many devices it is not the first cost but the upkeep and replacement which is becoming of real concern today.

With the growing shortage and increased demand for lead its price has soared. Lead for new lead-acid batteries and lead for replacement batteries is a major use. True a large part is recovered when a discarded lead-acid battery is exchanged for a new one, but there is an inevitable loss of lead. Man-hours and materials as acid, separators and battery cases are also lost. Besides the direct item of battery replacement cost, the indirect costs of equipment down-time awaiting and during battery change, delays because of battery failure on the road, and capital outlay for battery stocks must be reckoned with.

We have come to regard the periodic replacement of the lead-acid battery as routine. Much study has been given to other types of storage batteries such as the Edison nickel-iron and the Swedish nickel-cadmium alkaline cells. These latter have the advantage of a noncorrosive electrolyte on spillage, but the first cost is high, they are unsuitable for some services and the raw materials, especially the cadmium are also in short supply and badly needed for other purposes.

Many studies have been made (5, 6, 7, 22, 23) and many patents have been granted (8, 19, 25) for various modifications of the dilute sulfuric acid now universally used in lead-acid batteries. These additives are designed to cure the condition known as "sulfation" and many lurid and extravagant claims are made in their behalf. "Sulfation" is reduced, but the shedding of the active is also promoted and the early failure of the battery after the addition of the remedy has resulted in a universal discrediting of these additives (1, 2, 3, 4).

But sometimes the scientist is forced to admit that he does not know why an invention works, or by what manner of means the inventor finds his "flash of genius." Such an invention is manufactured and distributed under the name "Battery AD–X2" by Pioneers, Inc., 2411 Grove Street, Oakland 12, Calif. It is a recent battery additive, a powder which when added to the pure dilute sulfuric acid electrolyte maintains the active material in a "wanted condition." The physical condition of the active material on cycling the battery becomes such that it remains firmly in contact with the grid and shedding becomes an entirely negligible factor. It is worth while to examine some of the theoretical aspects of this situation.

EFFECT OF ADDED SALTS ON THE FORM AND SIZE OF LEAD SULFATE CRYSTALS IN SULFURIC ACID

It is well known among analytical chemists that the degree of purity of a solution is one of the most important factors in producing a filterable precipitate of exact composition. If foreign ions are present, they tend to be adsorbed on the precipitate, changing the composition and interfering with the rapid formation of filterable crystals. Even an excess of one of the reactants is undesirable if exact work, such as the determination of atomic weights, is in progress.

In general the effect of bivalent is greater than that of univalent ions, that of trivalent greater than that of bivalent, etc. In dilute solutions there is a well-recognized adsorption series of the ions as respects this adsorption.

As the concentration of the solution becomes greater, the effects become more complicated, but, in general, about the same order of effect is observed. It is found that there is a tendency in more concentrated solutions for more finely divided precipitates to be formed, often approaching the condition known as colloidal. Such precipitates are very difficult to filter. They are not of such definite composition and are more soluble than the more regular crystalline

precipitates formed in dilute solutions with approximately equivalent amounts of reacting ions. Most investigators regard these "colloidal" precipitates as having some at least of the regular lattice arrangement of the definite crystals, although it may exhibit much distortion due to the interference of the foreign ions of varying dimensions in the lattice.

Lead sulfate being composed of two bivalent ions is more liable to such distortions than are the crystals of salts formed of univalent ions. The properties of freshly formed lead sulfate in dilute solutions have been the subject of extensive and brilliant investigations by Kolthoff and his students (9 to 18) at the University of Minnesota. Kolthoff used dilute solutions in which the precipitation was substantially complete and it was shown that there was no appreciable supersaturation of the supernatent solution such as is common in active storage batteries.

Arndt (4) found 200, 218, and 418 mg. per liter and a still higher value in a slowly discharged battery whose acid density had sunk to 1.13. He found 824 mg. per liter in an acid of 1.125 density which he has used to make self-formed plates. In an active battery the lead sulfate is supersaturated. Only in the case of "sulfated" batteries did he find a solubility as low as 10 mg. per liter.

Kolthoff (9, 10) found the lead sulfate precipitated in dilute solution to behave initially as though the amicroscopic crystals were entirely porous—that is, as if all the lead ions within the fresh precipitate were present at the surface. They behaved as though they were filled with channels of mother liquor. On standing a tremendously rapid aging occurs which results in a perfection of the primary crystals. This perfection of the amicroscopic crystal does not result in a growth in the apparent size of the crystal, but is concerned only with the rearrangement of the ions of the crystal lattice. Actually, a distinct crystal growth, or increase in the size of the crystals, is noticed only after long periods of aging. The rate of aging is accelerated by digestion with nitric acid and by increasing the temperature.

Kolthoff (9) defined an external and internal surface. He measured the extent of the total internal and external surface by measuring the adsorption of thorium B, an isotope of lead, whereas the extent of the external surface was measured by the adsorption of wool violet, a dye whose organic molecule is too large to enter into the internal canals which are postulated to characterize the freshly formed crystal of lead sulfate.

In his second paper Kolthoff (10) showed that the speed of exchange of ions between the precipitate and solution is lessened by a large excess of lead nitrate. He also showed that the lead ions in the primary amicroscopic crystals, even in a precipitate 50 minutes old can move freely. The aging process has been shown to be one of the perfection of the arrangement of the ions in the lattice.

In the third paper (11) it is shown that the cementing together of the amicroscopic crystals is of minor importance. The aging of the particles takes place very rapidly in the beginning when the precipitate is just formed, but the crystals are not in thermodynamic equilibrium with their environment, even after long periods of aging. Because of the large excess of sulfate ion in the storage battery, the solubility of the lead sulfate is greatly decreased, although there is a marked tendency toward supersaturation of the electrolyte.

In their sixth paper (14) the precipitates from dilute solution were found to be more perfect and coarser than one formed from a more concentrated solution. This is in line with generally recognized principles and would indicate that the lead sulfate formed in the storage battery plates is of an exceedingly fine nature.

In their eighth paper (16) it is shown that the speed of distribution of lead ion in excess between the crystal and solution decreases with an increasing quantity of lead (and presumably also sulfate) ions in the solution. This is ascribed to the smaller speed of recrystallization attributed to the smaller solubility.

Sodium and magnesium ions are typical constituents (1, 2, 3, 4) of additives. When sodium and magnesium sulfate are added to sulfuric acid electrolyte there is a slight increase in sulfate ion, an increase in the bisulfate ion owing to the repression of the slightly weak dissociation of the bisulfate ion and thus a slight decrease in the hydrogen ion concentration. When magnesium sulfate is added there is also a some combination to form the complex $Mg(SO_4)_2$—ion, which because of its large size is more highly absorbed than is magnesium of sulfate ion.

It would thus appear that there are two different and distinct effects due to the presence of sodium and magnesium ions. Not only is the aging of the amicroscopic crystals of lead sulfate interfered with, but the adsorption of the foreign ions upon the enormously extended surface of these crystals is sufficient to greatly diminish the rate of growth of the crystals.

Arndt (4), who made extended studies of additives, showed that the size precipitated lead surfate crystals made in pure sulfuric acid was greater than when the precipitation was made from the same acid with added magnesium or aluminum sulfate.

SHEDDING

For some unknown reason batteries treated with known additives other than "Battery AD–X2," while showing better performance than untreated batteries, have shown a tendency to shed active material out of the plates, thus forming battery "mud." Shedding is caused largely by the detachment of particles along with the escape of gas from the plate. If the active material is hard ("sulfated"), it has a tendency to crack away from the grid, thus causing a high resistance between the active material and the grid. If the solution in the immediate vicinity of the discharge point of the electron is starved for lead ions or lead sulfate, oxygen will be evolved at the grid under the active material, thus promoting shedding.

Actually batteries treated with "Battery AD–X2" show very little shedding. After a few cycles of charge and discharge the active material in both positive and negatives is soft and in such firm contact with the grids (20) that there is a minimum of gassing during the charging cycle. When the plates have received their full charge the evolution of gas is observed in fine bubbles over the entire surface of the plate. With untreated batteries gassing seems to be greatest over the grids and the bubbles seem to be larger under the same condition of overcharge.

Another phenomenon is also observed. When fine particles of lead or lead peroxide are shed they sink to the bottom, where they are slowly acted upon by the sulfuric acid forming oxygen or hydrogen. The bubbles of gas rise to the top of the electrolyte, carrying with them small particles of battery mud. At the surface the bubbles escape, dropping their load of particles. Under the influence of the potential between the plates, these particles are attracted to the plates (21), where they lodge and gradually form additional active material. I have observed a rebuilding of active material in the places where active material has been dropped in old batteries which had been treated after "sulfation" and then remained in service for a long time. We may ask if this sort of circulation of active material may not be normal in lead-acid batteries, mud formation being positive or negative, depending upon whether shedding or flotation and redeposition is predominant (21).

SERVICE OF "BATTERY AD-X2" TREATED BATTERIES

The final test of a product is service.

Aging and growth of crystals is faster the higher the temperature. It is found that lead-acid batteries operating in equipment in hot semidesert runs will deteriorate rapidly. Likewise batteries in taxicabs the motors of which are often kept idling in traffic, are subject to high operating temperatures. The most spectacular achievements of "Battery AD–X2" would therefore be expected in this sort of service. I shall summarize a few of the adequately documented reports which are available.

An Oakland, Calif., manufacturer supplied batteries under guarantee to a local taxicab company. Because of excessive replacements under the guarantee they experienced heavy losses. With no other charge except the use of "Battery AD–X2" in the electrolyte no replacements have been asked for during the last nine months and one of the batteries have now more than 60,000 miles of service.

Two large corporations and other operating trucks, pipeline construction equipment, etc., in Saudi Arabia found very high battery costs. They adopted "Battery AD–X2" with satisfactory results, and have placed large repeat orders.

A large cement company delivering cement in bulk by heavy truck transports with trailers, using 150 pieces of equipment, report decidedly lower direct battery maintenance costs, with large savings due to elimination of downtime. Many "batteries that were considered unfit for further use (due to sulfation) were treated and are now out in equipment giving excellent untroublesome service."

Thousands of mechanically sound batteries from overseas equipment which were discarded because they would not take and hold a charge have been treated, and so far as reported not a single one of these batteries has failed during the last two years.

A California pipeline contractor using treatment in over 100 pieces of equipment has reported a direct item saving in battery expense of over 90 percent compared to the previous 12-month period without treatment.

A large trucking company reports a 95-percent saving in direct item battery expense (including repair of a broken post) and no battery failures since January 1, 1948, over the previous 8-month period without battery treatments.

In a large auxiliary tug the diesel starting battery was treated after being condemned. They are still in satisfactory service.

There is still much to be learned about the lead-acid battery. Performance such as has been described cannot be ignored. There is still a challenge in the study of some of our commonplace industrial products. Even though we may not know the reason why, yet we must accept the fact. Invention still has the element of "flash of genius" and progress is the taking advantage of invention no matter how achieved.

1. Anon. Letter Cir. LC 302, National Bureau of Standards. Washington, D. C., May 15, 1931.
2. Arndt, *Elecktrotech*, Z., 47, 934–36 (1926).
3. Arndt, *ibid.*, 49, 738 (1927).
4. Arndt, *ibid.*, 56, 122–124 (1935).
5. Bennett and Cole, *Trans. Am. Electrolchem Soc., 21.* 231 (1912). Chem, Eng. 15, 164–5 (1916).
6. Gladstone and Hibbert, *Phil. Mag., 30*, 162 (1890).
7. Hamilton, *Elect. World, 55*, 946–7 (1910).
8. Huick, Corman Patent 254,261, Oct. 28. (1908).
9. Kolthoff and Rosenblum, *I, J. Am. Chem. Soc., 56*, 1264–69 (1934).
10. Kolthoff and Rosenblum, *II, ibid., 56*, 1666–1671 (1933).
11. Kolthoff and Rosenblum, *III, ibid., 57*, 597–600 (1935).
12. Kolthoff and Rosenblum, *IV, ibid., 57*, 607–611 (1935).
13. Kolthoff and Rosenblum, *V, ibid., 57*, 2573–2577 (1935).
14. Kolthoff and Rosenblum, *VI, ibid., 57*, 2577–79 (1935).
15. Kolthoff and Rosenblum, *VII, ibid., 58*, 116–120 (1936).
16. Kolthoff and Rosenblum, *VIII, ibid., 58*, 121–122 (1936).
17. Kolthoff and Von Fischer, *XXIV, ibid., 61*, 191–194 (1939).
18. Kolthoff and Von Fischer, *XXV, ibid., 61*, 195–197 (1939).
19. Luckow, German Patent, 105,143, Sept. 4, 1895.
20. Morrison, U. S. P. 1,284,425, Nov. 12, 1918.
21. Pepper, U. S. P. 1,350,051, May 24, 1932.
22. Perley, *J. Phys. Chem. 15*, 439–507 (1911).
23. Perley and Davis, *J. Phys. Chem. 20*, 164–67 (1910).
24. Probert, *Telegraphic and Elect. Rev., 20*, 94 (1887).
25. Trowbridge, *U. S. P.* 551,565, Dec. 17, 1895.
26. Vinal and Schramm, *J. Am. Inst. Elect. Eng., 44*, 128–32 (1925).

The CHAIRMAN. As you hear, that is the quorum bell right now, but we will continue until we get the second one, and then we will recess.

Mr. RITCHIE. After a great deal of correspondence with the National Better Business Bureau by the Oakland Better Business Bureau, the Oakland Better Business Bureau sent a confidential memorandum to all bureaus informing them that they had investigated us thoroughly, and that we were reputable people, that they had investigated our customers, and they were satisfied customers; and they sent this to all their members. I would like to make this a part of the record.

The CHAIRMAN. That will be made a part of the record.

(The document referred to follows:)

BETTER BUSINESS BUREAU OF METROPOLITAN OAKLAND,
Oakland, Calif., February 21, 1949.

CONFIDENTIAL MEMORANDUM TO ALL BUREAU MANAGERS

Re: Pioneers, Inc. (AD–X2) formerly known as "Protecto-Charge," 2411 Grove Street, Oakland 12, Calif.

During the past two years many inquiries have been received by the Oakland Bureau for a full story on the promotion of a product formerly known as "Protecto-Charge," and now known as "AD–X2." The attached report is a factual report. I am taking the liberty, however, in this cover letter to pass along some personal observations for what they are worth.

I have interviewed not only Jess M. Ritchie, President of Pioneers, Inc., but Dr. Merle Randall, Professor Emeritus in Chemistry at the University of California and presently senior partner of Randall & Son, Consulting Chemists. I have also talked at some length with Dr. Frederick G. Sawyer, Associate Editor of Chemical and Engineering News. These men are able and qualified, and their opinions are worthy of confidence. They concretely state that the product known as "AD–X2" differs from other battery additives in that the product reduces sulfation without causing shedding (shedding being the loosening of active material in the plates and the subsequent sinking of this material in the bottom of the container in the form of battery mud).

The U. S. Bureau of Standards, Circular #302, specificaly condemns battery additives composed of sodium sulphate and magnesium sulphate on the inclusive condemnation that these products are Epsom Salts and Glauber Salts. It is Dr. Randall's contention that these two chemicals when used in certain combinations with other elements do not form Epsom or Glauber Salts, but form a new compound which does not possess the harmful qualities of the above-named salts. Numerous attempts have been made by Pioneers, Inc., Dr. Merle Randall, Senator William Knowland, and I, to get the Bureau of Standards through the Chief of Electro-Chemistry Division, Dr. George W. Vinal, to give this product a fair test to either prove or disprove the statements made in this Circular. In every case, the only courtesy received from the Bureau of Standards has been a statement that further test is unnecessary in that the product is admitted by its manufacturers to contain sodium sulphate and magnesium sulphate.

I have personally interviewed R. R. Little, of the Permanente Cement Company; R. B. Lohry, Engineer for the City of Oakland; James Dinwiddie, of the Dinwiddie Construction Company; and James Grifall, of Grifall Bros. Trucking Company. I have also talked with H. C. McBroom, of Stolte, Inc., General Contractors. Each one of these men has confirmed his statements in the attached testimonial letters as to the value and use of this product AD–X2, and as to the accuracy of the tests they have made.

The Better Business Bureau of Oakland has had a test made of the product by an independent and disinterested chemical laboratory, who states that the chemical content of this product is sodium sulphate (NA_2SO_4) 60.16; magnesium sulphate $MgSO_4$) 28.64; magnesium oxide (MgO) 6.95; combined water (H_2O) 3.82. Mr. Ritchie, of Pioneers, Inc., states that this chemical analysis is the most accurate he has seen.

As a result of my close personal contact with this entire investigation, I have reached the conclusion that Better Business Bureaus do Pioneers, Inc., a rank injustice by including this product in the general category of battery "dopes." Careful analysis of the company's advertising will reveal that they have bent over backward in an effort to explicitly and accurately state what the product can do and what it is *not* capable of doing.

It is my personal opinion that the principals and scientists associated with this organization are sincere in their desire to give this product any test which will prove the product is harmful or has the capacity to harm any battery or that it will not perform in accordance with the claims they make for it. Upon reviewing this file, we would welcome the suggestions any one of you might make for further tests, or suggestions in order to determine the merit of this firm's claims.

May I again point out, my reason for this confidential memorandum is my honest belief that this firm (which is, incidentally, a member company from prior to my assuming managership of this Bureau) is being given unfair treatment because of generalization with reference to battery "dopes."

JACK A. HARRIS, *General Manager.*

JAH: mc

Mr. RITCHIE. On May 9, 1949, the Oakland Better Business Bureau sent a memorandum to all western State bureaus on generalization in bureau reports, and condemning products; and they cited this product as an instance where a business was being hurt by generalization, and asking for an opportunity to make up a memorandum to send to the national bureau by all bureaus, and to protest this action.

I would like to make that a part of the record.

The CHAIRMAN. That will be made a part of the record.

(The document referred to follows:)

BETTER BUSINESS BUREAU OF METROPOLITAN OAKLAND, INC.,
May 9, 1949.

MEMORANDUM TO ALL WESTERN STATES BUREAUS

Re Generalization in Bureau Reports.

I write to get your opinion regarding the use of generalizations in Bureau reports from the point of view of National policy. To illustrate my point, I use Pioneers, Inc., for the problem which affects this Company can well affect other Companies as well, and this is an excellent case at hand.

Pioneers, Inc., is the manufacturer of AD–X2, a battery compound designed to aid in the desulfation of plates in lead-acid storage batteries. There has been much national interest in so-called "battery dopes," largely because most of these are either an epsom- or glauber-salt compound. AD–X2 has been declared by Dr. Merle Randall, Professor Emeritus in Chemistry, University of California; the Bonnickson Laboratories; and the Twining Laboratories, to be other than an epsom- or glauber-salts product, and absolutely nonharmful to batteries. This Bureau has verified the testimonials of many major users of AD–X2, all of whom contend that the product proved valuable, both in lengthening the life of batteries and restoring the usefulness of mechanically sound but heretofore "junked" batteries.

The National Bureau, as well as the Oakland Bureau and the firm itself, have endeavored to get the National Bureau of Standards to test the product to determine whether or not it is harmful to batteries. This has been felt necessary because of the National Bureau of Standard's General Circular No. 302, which more or less condemns all battery compounds with a base of sodium sulfate or magnesium sulfate as being harmful. NBS has refused to make a test. As a result of this refusal on the part of NBS, and in spite of overwhelming evidence to the contrary, plus the prestige of the scientists and laboratories backing the product, our National Bureau has continued to send inquiries regarding AD–X2 and Pioneers, Inc., the generalized circular on battery compounds which, as you know is unfavorable.

My argument is this: Until the National Bureau and/or any legitimate laboratory, free from selfish interests, can offer evidence to the effect that there exists any misleading or untrue claims in the Company's advertising, or harmful effect from the product, then neither National Bureau, nor any local Bureau, has any right to issue a report other than a strictly factual report such as the one issued by the Oakland Bureau; (see attached) which report is based upon investigation and contact with recognized scientific authorities and field users of the advertised product.

In fairness to all producers of a new product, it is my belief that we should object to this practice. For this reason, I would like to have your permission to address a letter to National Bureau in the form of a resolution by the Western States Bureaus to the effect that, until evidence to the contrary is produced with reference to any specific product, or advertising claim, we of the Western States Bureaus do not believe that any information which might have an unfavorable interpretation should be issued in connection with that product or firm.

May I have a prompt response from each of you as to whether or not you are in accord with my thinking? I strongly believe that this is an important question of over-all Bureau policy.

BETTER BUSINESS BUREAU OF METROPOLITAN OAKLAND, INC.,
(S) JACK A. HARRIS, *General Manager.*

JAH: jbj.
1 attachment.

Mr. RITCHIE. Here is a letter dated August 30, 1949, after the new Battery Compounds and Solutions had come out, from the general manager of the Oakland Better Business Bureau to the general manager of the National Better Business Bureau pleading with him to discontinue the distribution of these pamphlets. I would like to make that a part of the record.

The CHAIRMAN. That will be made a part of the record.

(The letter referred to follows:)

BETTER BUSINESS BUREAU,
OF METROPOLITAN OAKLAND, INC.,
Oakland 4, Calif., August 30, 1949.

Re: Pioneers, Inc., Oakland, Calif.

Mr. KEN WILLSON,
Operating Manager, National Better Business Bureau, Inc.,
Chrysler Building, New York, N. Y.

DEAR KEN: I feel that I must once more talk to you on the subject of Pioneers, Inc., and its product, "AD–X2". Seriously I ask you to carefully read what I have to say, not in the interest of Pioneers, Inc., the Oakland Bureau or the writer, but in the interest of the principles which we in the Bureau movement believe in and try to promote * * * the furtherance of free enterprise. I honestly believe that you (and through you, the National Better Business Bureau) are being party to a practice which affects not only Pioneers, Inc., but any firm pioneering in a new field. But let me tell you how I see it.

You know the history of Pioneers, Inc., by virtue of your long investigation, the Oakland Bureau's report and the numerous pieces of correspondence you have received in re this subject. That you may know a bit more of Mr. Ritchie, he is a general contractor, class A license in the State of California and has supervised a number of major projects. He became interested in battery compounds quite accidentally through a business contact with one Donald Keifer who subsequently proved to be "sour". Ritchie bought into Keifer's formula, entered a partnership with him and then discovered that the product he and Keifer were selling was no better than the other standard "dopes". Upon making this discovery, Ritchie employed Dr. Merle Randall, a nationally famous chemist, and Professor Emeritus of Chemistry at University of California to assist him in stabilizing this compound (then known as Protecto-Charge) and to help him develop if possible, a process which would produce a stable, nonharmful, yet effective battery additive which would actually be an agent capable of desulfating battery plates. In this they were successful. The resulting product, which is now known as AD–X2 was then exchanged without charge for all previous customers possible; each was told that the previous product had been unintentionally misrepresented, and the new product furnished in substitution. In the meantime, the partnership with Keifer was dissolved. I think you will agree with me that this is an indication of Jess Ritchie's integrity.

A careful examination of the advertising matter used by Pioneers, Inc., will show that all claims made for the product are clear and complete, and that generalizations are avoided. Specific point is made that the product is recommended for use by experienced battery men only, and that all advertising has been directed to battery men and not to the general public. Most ads are carried in automotive trade journals, chemical publications, and dealer media. The product is guaranteed to users to be noninjurious to the battery. No advertising is published without careful editing for accuracy and scientific validity by Dr. Merle Randall. Again this points to the integrity and sincerity of the firm and its management.

The product has been analyzed by Twining Laboratories, and the Kenneth Bonnickson Laboratories, both of which are recognized as leading laboratories in the West, and both have unhesitatingly stated that there exists nothing in the product which can in any way prove harmful to a battery. Both further state that although the product contains magnesium sulphate and sodium sulphate, it is not present in the form of Epsom or Glauber salts. Ritchie has previously stated his willingness to submit the product to any recognized laboratory for examination or test providing: (1) the laboratory is willing to give the product an unbiased test which will test the additive under field or simulated field condition and not a "life-cycle test" which is and has proven to be ineffective; and (2) the laboratory is not presently nor previously connected in any way with the battery industry. I am sure you will agree that these requests are reasonable.

Users of AD–X2, who are not "fly-by-nights," but bona fide and experienced fleet operators not only testify to the effectiveness of the product, but evidence their sincerity by repeat orders and continued use over a period of 2 years. I have personally talked to many of these customers and can vouch for their willingness to swear to the product's efficiency.

Each of the men connected with Pioneers, Inc., are persons of prestige and excellent personal qualifications. Aside from Mr. Ritchie, Merle Randall is a national authority in chemistry; Mr. W. M. Hager is a college graduate, qualified engineer, and a man of broad engineering background; and Robert Eckhoff, attorney for the firm, is also a chemical engineer and nationally known patent attorney. Every indication supports the belief that this operation is not another "sharp deal" in the field of "battery dopes."

And * * * in spite of all this, continued distribution is made of the April 15, 1949 bulletin Battery Compounds and Solutions quoting the National Bureau of Standards and their admittedly limited testing of some 40 out of over 1,500 battery additives. This bulletin unfairly generalizes and classifies all battery additives as "undesirable." Yet apparently National Better Business Bureau has never prepared a report on Pioneers, Inc., nor has it reasonable or fairly qualified its statements regarding battery dopes in such a way as to give margin to the possibility that there may be on the market a compound which is scientifically and practically effective.

Here, Ken, is the issue as I see it. In my opinion, neither you nor the National Better Business Bureau nor any other organization in God's green earth have the right to participate in preventing a man from carrying on free enterprise by direct or indirect means unless there is a reasonable basis for such an action. Yet in this instance there is a product which has been proven beyond all reasonable doubt to be both valuable, effective, and none harmful, and quite possibly may prove to be a serious contribution to the scientific development of the business. Are you not, then, emasculating basic Bureau objectives and destroying the virility of our program to build consumer confidence in business by the attitude that National Business Bureau has taken in this instance?

Won't you please give serious consideration to these thoughts and give me an answer?

Sincerely yours,

/s/ JACK HARRIS,
General Manager.

cc: Mr. Victor Nyborg, Assoc.-Pres., A. B. B. B.
Mr. Edward L. Greene, Gen. Mgr., N. B. B. B.
Muriel Tsvetkoff, General Mgr., S. F. B. B. B.

Mr. RITCHIE. On August 25, 1949, the industrial manager, manufacturer's division of the Oakland Chamber of Commerce wrote a letter to Edward L. Greene, general manager, National Better Business Bureau, N. Y., pointing out that the reputation of the personnel of Pioneers, Inc., was such that we would not sponsor a dubious product, and asking them to give consideration to discontinuing blanket condemnation of battery AD–X2.

I would like to make that a part of the record.

The CHAIRMAN. That will be made a part of the record.

(The document referred to follows:)

OAKLAND CHAMBER OF COMMERCE,
417 FOURTEENTH STREET,
Oakland 12, Calif., August 25, 1949.

Mr. EDWARD L. GREENE,
General Manager, National Better Business Bureau, Inc.,
Chrysler Building, New York 17, N. Y.

DEAR SIR: We are writing you concerning your pamphlet "Battery Compounds and Solutions" which is working a definite hardship on one of our member firms, Pioneers, Inc. As this is contrary to the aims and purpose of your organization, we feel certain that you will wish to take the necessary steps to alleviate the situation when you become aware of the facts of the case.

We realize that for the protection of the public, your pamphlet "Battery Compounds and Solutions" has a definite place and were it not for the pamphlet there would be more victims than already exist of the "Battery Dope racket". However, Pioneers, Inc., should, in our opinion, be definitely excepted as regards such a publication. With all due respect to the National Bureau of Standards, whom you quote in your pamphlet, we feel that they have not been exactly cooperative regarding the product "Battery AD–X2", manufactured by Pioneers, Inc.

In answer to a local businessman's inquiry about "Battery AD–X2", Dr. Vinal

of the Bureau of Standards states in a letter, dated February 15, 1949: "We can give you no definite information in regard to the specific material about which you inquired. This Bureau does not endorse any of these compounds and we believe the matter was fully explained in our Letter Circular No. 302 to which you referred. Although this was issued some years ago we believe that the statements which it contains are valid today." We assume this statement represents the Bureau of Standards attitude toward "Battery AD–X2" as they have been requested several times to test the product, which they refuse to do.

This organization investigated Pioneers, Inc., prior to their becoming members of the Chamber of Commerce some two years ago. The officers of the corporation enjoy such a reputation in this community that they undoubtedly would not sponsor a dubious product or venture. In this connection, we particularly direct your attention to the fact that Dr. Merle Randall is Vice President of Pioneers, Inc. Dr. Randall is a nationally known chemist and an outstanding authority on lead-acid batteries. Further details as to his activities can be found in "Who's Who in America" and "American Men of Science."

The President of Pioneers, Inc., Mr. Jess M. Ritchie, holds a General Contractors' Class A license in the State of California, which is an outstanding tribute to his ability in the construction field. He has been General Superintendent on some of our largest western projects and enjoys the confidence and respect of many of the outstanding construction companies of this community.

Pioneers, Inc. do their advertising only in leading technical journals. Also, we have been advised that they have been thoroughly investigated by Chemical Engineering Society as well as other leading technical publications and that the results of these investigations have lead those publications to print articles favorable to the product "Battery AD–X2".

We are enclosing a brochure which Pioneers, Inc., use in their advertising. We request you bear in mind that with few exceptions those letters are signed by principals of the companies attesting to their experience with "Battery AD–X2", also, that most of these principals are engineers. The statements contained in these letters and the statements contained in your publication "Battery Compounds and Solutions", are at variance. This variance, as we previously mentioned, is working a hardship on Pioneers, Inc., and is unjust.

It is not the policy of the Oakland Chamber of Commerce to endorse products, but it is our understanding that Pioneers, Inc. have treated thousands of batteries over a period of the past two years and has not one dissatisfied customer. Nor has one dissatisfied customer been reported to the Better Business Bureau of Los Angeles, the Better Business Bureau of San Francisco, Ltd., the Better Business Bureau of Reno, Nevada, or the Better Business Bureau of Oakland, California. Therefore, we wholeheartedly request in the interest of justice, that your organization give proper publicity to the fact that Pioneers, Inc., are not to be confused with the people or products outlined in your pamphlet "Battery Compounds and Solutions".

Respectfully yours,

/s/ KEN MOELLER,
Manager, Manufacturer's Division.

Mr. RITCHIE. On September 12, 1949, the Director of the National Bureau of Standards wrote a letter to Dr. Randall. I would like to make that letter a portion of the record.

The CHAIRMAN. That was the Director of the Bureau of Standards?

Mr. RITCHIE. Yes, sir.

The CHAIRMAN. Whose name is that letter signed by?

Mr. RITCHIE. E. U. Condon.

The CHAIRMAN. That will be made a part of the record.

(The document referred to follows:)

U. S DEPARTMENT OF COMMERCE,
NATIONAL BUREAU OF STANDARDS,
Washington 25, September 12, 1949.

DR. MERLE RANDALL,
Randall & Sons, 2512 Etna Street, Berkeley 4, Calif.

DEAR DR. RANDALL: Your letter of August 17 (acknowledged on August 22 in my absence by Dr. Crittenden) has just been brought to my attention. I am sorry to note that so much time has slipped by since your earlier letter of January 10 was received. At that time we had heard that tests of "Batteries

AD–X2" were then under way both at the New York Naval Shipyard and at the Signal Corps Engineering Laboratories, Fort Monmouth. We expected these would be completed shortly and a reply to your letter was postponed so that a comment based on their results might be included. Unfortunately by the time this report was received the matter had slipped my mind. Please accept my apologies for this inadvertence and be assured that there has been no "breach of protocol" in your correspondence with Dr. Vinal. Dr. Vinal tells me that the opening phrase of your letter of July 27, 1948, "I do not wish to unduly prolong our communications," led him to understand that you and he had "agreed to disagree" and that you wished to close the discussion. It seemed to him also that further correspondence was not likely to lead either of you to change his opinion. Your letter to him of December 31, 1948, did not change this situation appreciably.

Coming now to technical matters, from the carbon which you sent me of Mr. Ritchie's letter of August 17, 1949, to the Signal Corps, it is evident that you know of the results of their tests, and of those at the New York Naval Shipyard. It seems to both Dr. Vinal and me that these tests were practical in nature, carried out carefully and with reasonable controls. They led those agencies to conclude that "Battery AD–X2" had no merit in reclaiming badly sulfated lead-acid storage batteries. We feel that laboratory tests of this nature in which the capacities of the cells are measured quantitatively, and the condition of the plates before and after the tests are observed and compared with similar control cells which have not been treated are much more significant than the so-called "service tests," which merely report that a number of batteries which had at one time been discarded have been reclaimed and given further useful lives. Garage operators are all too prone to discard batteries which still have much active material, and there is no way of knowing from such testimonials that a given battery would not have recovered equally well without the use of an additive.

Your own laboratory reports (enclosures B, C, and D with your letter of August 17, 1949) are open to the criticism that there is no way of knowing that in each of the three batteries the particular cells which you chose to treat with AD–X2 were in fact in as bad a condition as the others at the beginning of the test.

I was glad to note from your letter of January 10, 1949, that Pioneer's, Inc., realize the impropriety of using the results of government tests for advertising purposes, and trust that they will continue to maintain this correct attitude. One phrase in your letter implies that you may be misinformed on a related matter. Other agencies of the Federal government are not obliged to "ultimately require an aproval by the U. S. National Bureau of Standards." The Bureau issues no formal "approvals" in the sense that the word is used, for instance, by the Underwriters Laboratories. We merely report the results of each of our experimental tests to the government agency which requested it and that agency is free to make such use of it as it desires. This is one of the reasons why we consistently decline to make tests of commercial products for private concerns, except for calibration tests which serve to disseminate the units of measurement.

We believe that the statements in our Letter Circular 302, prepared as part of our informational services to the public, have been of material value in protecting battery users from wasting their money on useless additives although none of these products has been mentioned by name. In your letter of January 10, you concur in these statements as applied to your competitors. Also, your letter of July 8, 1948, to Dr. Vinal states the chemical composition of AD–X2 and shows that it is such that when dissolved in battery electrolytes, it is bound to become identical with the solutions resulting from a number of these other worthless additives. The lack of merit thus to be anticipated has been confirmed independently by the New York and Fort Monmouth tests. In view of these facts I do not see how further consideration by us of the facts now available to us can possibly lead to a specific exemption of your product from the implications of Letter Circular 302.

Sincerely yours,

E. U. CONDON, *Director.*

Mr. RITCHIE. Shortly after receiving that letter we collected a large number of affidavits from large industrial accounts and military personnel who had used thousands of treatment packages of the material, as to the effectiveness of the material, and they were sent to the

Director of the Bureau of Standards, and are to this date not acknowledged.

The CHAIRMAN. You mean that these letters that you have there—that you desire to have them incorporated in the record, and the letters endorsing the product, letters from the users of the product?

Mr. RITCHIE. I believe that the committee has had these affidavits brought up to date more recently by the same people.

The CHAIRMAN. You are just referring to the documents which I introduced and said that they would become a part of the record?

Mr. RITCHIE. Yes, sir. These documents pointed out that the people had cut their battery costs by 50 percent; that they had extended their battery life by double. Here is 1 man who saved a $3,000 bank of batteries by treating the batteries. They were still working. Here is a man who used over a thousand treatment packages.

The CHAIRMAN. Have you any documents or any letters in your files wherein some users have complained that the product was of no benefit or value to extend the life of his battery?

Mr. RITCHIE. No, sir; I do not.

The CHAIRMAN. You do not have any in your records?

Mr. RITCHIE. No, sir; I do not.

Under our guaranty system, we have had maybe a half dozen letters over a period of 5 or 6 years asking for refunds on batteries out of our area.

We sent a new battery and a batch of treatments to Washington a few years ago because it was the first treatment. This man bought a battery back there and brought it back here and the battery failed.

The CHAIRMAN. When you say "back there," what do you mean?

Mr. RITCHIE. He bought it in Oakland, Calif. He was stationed here, and the battery failed, but he bought a $3 treatment from us, and the battery was too old to treat. So he wrote back and sent us his sales slip or his receiving slip on the battery and asked for a refund of the $3. We added the $3 to the price of the battery, wrote him a check for the battery and the treatment, and enclosed the treatment package of Battery AD–X2.

When we find a customer who has had a little tough luck, we go all out to see that the boy is satisfied.

The CHAIRMAN. You mean you refund the cost of the compound?

Mr. RITCHIE. Bought the battery and also sent him a package treatment of AD–X2.

The CHAIRMAN. What was the cost of the battery?

Mr. RITCHIE. I think it was something like $27. They happen so rarely it doesn't mean anything. It is more of a stunt than anything else, if you know what I mean.

The CHAIRMAN. I do not know what you mean. I am just trying to get at the facts.

Mr. RITCHIE. That rarely happens, and when this happens we really go all out. We give the fellow the price of the battery, the treatment, and the new treatment, and he is happy forever after.

The CHAIRMAN. You may proceed, sir.

Mr. RITCHIE. At this point I would like to introduce into the record a test that was run by the University of San Francisco on December 13 of 1949 in which they took 6 batteries that they had been trying for 2 years in the physics department to charge, and which would

not take a charge. After treatment and without any other changes at all, why, the batteries did take a charge.

The CHAIRMAN. Who ran that test?

Mr. RITCHIE. That test was run by Father Alexis I. Mei, chairman, physics department, University of San Francisco.

The CHAIRMAN. That will be made a part of the record.

(The document referred to follows:)

UNIVERSITY OF SAN FRANCISCO,
DEPARTMENT OF PHYSICS,
San Francisco 17, Calif., December 13, 1949.

Subject: Test of "Battery AD–X2" as manufactured by Pioneers, Inc., 2411 Grove Street, Oakland 12, Calif.

Battery History: Batteries 110 ampere-hours at the 20-amp. rate SLI. Manufacturer: Willard. Batteries first installed in instruction bench, Physics Department, University of San Francisco, in 1941.

The batteries were used from 1941 until 1947 without incident. In late 1947 until late 1948 the batteries became very difficult to charge. From late 1948 to September 1949 it was impossible to give the batteries a useful charge. On September 27, 1949, one treatment package of "Battery AD–X2" per battery was obtained.

We were told by Pioneers, Inc., that it was against company policy to treat batteries of this type which were over 6 months old, in composition cases or those in hard rubber cases which were over 1 year old without first pulling the batteries for visual inspection and necessary repairs. However, after our explanation that we wanted to use the material for test purposes, it was explained that if the batteries were treated in place without any change in installation or charging apparatus, that some indication of "Battery AD–X2" action would possibly be apparent. This was done. No change in installation or charging was made. On September 29, 1949, the specific gravity of all cells was below indication on standard hydrometer. The open-cell voltages prior to treatment and charge were as follows:

Battery	(P) cell 1	(C) cell 2	(N) cell 3	Battery	(P) cell 1	(C) cell 2	(N) cell 3
No. 1	1	1	[1] 2	No. 5	0	0	2
No. 2	0	0	2	No. 6	0	0	2
No. 3	0	0	2	No. 7	0	0	2
No. 4	0	0	2				

[1] Voltage only approximate.

NOTE.—Charging voltage at batteries, 51 volts; distance from Tungar charger to batteries, 190 feet; voltage at charger, 61 volts.

The charger was turned on at 2 amps and the batteries were treated with "Battery AD–X2." The batteries were left on charge at 2 amps for 37 hours, at the end of which time the open voltage was sufficient for the batteries to properly function on the instruction bench.

On October 5, 1949, the open voltages were as follows:

Battery	(P) cell 1	(C) cell 2	(N) cell 3	Battery	(P) cell 1	(C) cell 2	(N) cell 3
No. 1	2	2	2	No. 5	2	2	2
No. 2	2	2	2	No. 6	2	2	2
No. 3	2	2	2	No. 7	2	2	
No. 4	2	2	2				

No furthur check of the batteries was made other than routine, of which no record was kept.

On November 27th and 28th the batteries were put on intermittent charge for 28 hours at a 7 amp. rate. At the end of this period on November 29th, the following readings were taken with batteries still on charge.

Room temperature, 77° F.

	(P) cell 1	(C) cell 2	(N) cell 3	Battery temperature
				Degrees Fahrenheit
Battery 1:				
Voltage	2.35	2.35	2.40	
Hydrometer	1280	1260	1200	79
		½ gill acid added to cell 2	1 gill acid added to cell 3	
Battery 2:				
Voltage	2.33	2.35	2.40	
Hydrometer	1280	1275	(1)	80
		½ gill acid added to cell 2	Water added to cell 3	
Battery 3:				
Voltage	2.38	2.33	2.41	
Hydrometer	1300	1250	1190	84
		½ gill acid added to cell 2	½ gill acid added to cell 3	
Battery 4:				
Voltage	2.35	2.34	2.40	
Hydrometer	1300	1260	1190	84
		½ gill acid added to cell 2	1 gill acid added to cell 3	
Battery 5:				
Voltage	2.37	2.32	2.42	
Hydrometer	1280	1260	1150	84
		½ gill acid added to cell 2	1 gill acid added to cell 3	
Battery 6:				
Voltage	2.36	2.33	2.42	
Hydrometer	1290	1260	1175	85
		½ gill acid added to cell 2	1 gill acid added to cell 3	
Battery 7:				
Voltage	2.39	2.38	2.42	
Hydrometer	1290	1260	1175	84
		½ gill acid added to cell 2	1 gill acid added to cell 3	

[1] No electrolyte.

NOTE.—Acid added as indicated above was of 1400 specific gravity charging discontinued at 3 p. m., on Nov. 29, 1949.

On the following day, November 30, 1949, 21 hours after charging was discontinued, open-voltage tests, hydrometer readings, and temperatures were as follows:

Room temperature: 75° F.

	(P) cell 1	(C) cell 2	(N) cell 3	Battery temperature
				Degrees Fahrenheit
Battery 1:				
Voltage (open)	2.12	2.12	2.10	74
Hydrometer	1300	1280	1285	
Battery 2:				
Voltage (open)	2.12	2.12	2.10	75
Hydrometer	1270	1280	1260	
Battery 3:				
Voltage (open)	2.12	2.10	2.05	74
Hydrometer	1290	1275	1250	
Battery 4:				
Voltage (open)	2.15	2.15	2.12	74.5
Hydrometer	1280	1280	1250	
Battery 5:				
Voltage (open)	2.15	2.13	2.05	74
Hydrometer	1300	1280	1260	
Battery 6:				
Voltage (open)	2.15	2.10	2.10	75
Hydrometer	1300	1285	1265	
Battery 7:				
Voltage (open)	2.15	2.15	2.15	75
Hydrometer	1280	1285	1275	

Batteries put on charge at 12 noon, November 30, 1949. Water level adjusted. Batteries charged at 4 amps. Charging ended at 2 p. m. Batteries then put on discharge at 2 p. m. at the 1 amp. rate until 9 a. m., December 1, 1949.

The discharge rate was then changed to 2 amps. The 2 amp. discharge was continued until 3 p. m., December 1, 1949, at which time the following voltage and hydrometer readings were taken while the batteries were still under 2 amp. load.

	(P) cell 1	(C) cell 2	(N) cell 3
Battery 1:			
Voltage	2.00	2.00	1.98
Hydrometer	1250	1240	1250
Battery 2:			
Voltage	1.98	1.98	1.95
Hydrometer	1255	1240	1225
Battery 3:			
Voltage	2.00	1.99	1.93
Hydrometer	1260	1240	1240
Battery 4:			
Voltage	2.00	2.00	1.98
Hydrometer	1250	1245	1240
Battery 5:			
Voltage	1.98	1.98	1.91
Hydrometer	1250	1240	1235
Battery 6:			
Voltage	2.00	2.00	1.99
Hydrometer	1260	1255	1225
Battery 7:			
Voltage	2.00	2.00	2.00
Hydrometer	1250	1250	1250

All batteries are now in normal service.

(Signed) ALEXIS I. MEI, S. J.,
Chairman Physics Department,
University of San Francisco, Calif.

AIM;vm.

The CHAIRMAN. Mr. Ritchie, how long will it take you to complete your statement providing you are not interrupted?

Mr. RITCHIE. If I am not interrupted and can just run through and put the statements in, I believe I can make it in 30 minutes.

The CHAIRMAN. Well, you may proceed. We have had one quorum call, but we may have another in a moment.

Mr. RITCHIE. The life-cycle test has long been a situation—I will not make these a part of the record, they would be too extensive, but I would like to point out that Dr. Randall pointed out to the Bureau for years that the life-cycle type of test could not show anything where Battery AD–X2 was concerned because in the life-cycle type of test the batteries constantly are exercised; there is no chance for the aging of the lead sulfate. According to these two papers here, part I, laboratory test by Hatfield and Harner in 1937, and the second paper by Hatfield and Harner in 1937—they, being with the Eagle-Picher people should know—they proved the only thing you could find out with a life-cycle test is that you could not prove anything.

Here is a letter from Condon to Randall dated December 23, 1949, pointing out if we would use water, why, we would have the same results.

The CHAIRMAN. Who is Mr. Condon?

Mr. RITCHIE. He was Director, National Bureau of Standards.

The CHAIRMAN. We just want the record to be clear on it.

Mr. RITCHIE. Yes, sir. May I submit this for the record?

The CHAIRMAN. Yes.

(The letter referred to follows:)

U. S. DEPARTMENT OF COMMERCE,
NATIONAL BUREAU OF STANDARDS,
Washington 25, December 23, 1949.

Dr. MERLE RANDALL,
Randall and Sons,
2512 Etna Street, Berkeley 4, Calif.

DEAR DR. RANDALL: Acknowledgment is made of your letter of November 10, 1949, with inclosures in answer to the questions raised by the members of our staff.

After thoroughly digesting the material and discussions, it is quite apparent from past experience that the same thing would be accomplished if the batteries were rebuilt and low-gravity acid or water added as the electrolyte without adding the AD–X2.

It is an old-established fact that batteries may be rebuilt and given the water treatment to remove sulfate from the plates. There is no need for anything else to be added. It is therefore suggested that you investigate this phase, if you are interested in finding the answer to your so-called mystery "as to why AD–X2 works." If you carry out the treatment as specified on the package without removing the battery elements from the case, the results will be the same as all other laboratories have reported, i. e., no noticeable effect.

Very truly yours,

E. U. CONDON, *Director.*

Copy to:
Senator Wm. F. Knowland.
Mr. K. B. Willson, National Better Business Bureau.

Mr. RITCHIE. This shows how the battery manufacturers were using these Battery Compounds and Solutions. You would write and ask them what they thought of Battery AD–X2, and they would write back and send you a copy of Battery Compounds and Solutions, a pamphlet issued by the Better Business Bureau of New York. They would make absolutely no statement that would bother them at all. They would say, "Enclosed for your information is Battery Compounds and Solutions which gives the position of the National Bureau of Standards and National Better Business Bureau on battery additives." I would like to make those letters a part of the record.

The CHAIRMAN. That will be made a part of the record.

(The documents referred to follow:)

GLOBE-UNION INC.,
900 EAST KEEFE AVE.,
Milwaukee 1, Wis., January 3, 1950.

Mr. ERNEST SILVA,
Silva's Auto Wrecking Co.,
1510 University Avenue,
Berkeley, Calif.

DEAR MR. SILVA: In reply to your letter of December 26, 1949, it has been our experience as a battery manufacturer that the use of additives to storage batteries has not been beneficial and, therefore, we, as a manufacturer, do not recommend the use of such materials.

For your convenience we are enclosing a pamphlet on Battery Compounds and Solutions as issued by the National Better Business Bureau, Inc.

Yours truly,

GLOBE-UNION, INC.,
W. W. RUSSELL,
Battery Sales Department.

WWR:EM.
Enc.

Battery Compounds and Solutions—An Important Statement on the Subject of Battery Additives From the National Bureau of Standards

National Better Business Bureau, Inc., Chrysler Bldg., 405 Lexington Ave., New York 17, N. Y.

Because of an increasing number of inquiries on so-called battery "dopes," NBBB sought up-to-date information from the National Bureau of Standards on the subject for the information and guidance of media and the public. We quote below a statement dated March 9, 1949, from Dr. E. U. Condon, Director of the National Bureau of Standards.

BUREAU OF STANDARDS STATEMENT

"The National Bureau of Standards receives many inquiries about preparations which are said to 'charge' or 'rejuvenate' storage batteries. Over a period of 25 years a large number of such battery additives have been exploited. Some 40 or 50 of these preparations have been tested and analyzed. For the most part these compounds and solutions have as principal ingredients either or both magnesium sulphate and sodium sulphate. In the hydrated condition these are known as Epsom salts and Glauber's salt respectively. They are often used, however, in various lesser states of hydration in which case these common names do not apply. When the salts are dissolved in water solutions, it is immaterial whether hydrated or dehydrated salts are employed, provided the same actual weight of the salt exclusive of its water of hydration is employed. In various samples other constituents were indicated, including: aluminum sulphate, potassium sulphate, ammonium sulphate, several kinds of alum, glycerin, chromates, phosphates, sulphuric acid, salts of copper and iron, and organic coloring agents. Whatever effect these materials may have in a storage battery when added to the standard electrolyte for such batteries, this Bureau has never found any evidence that they affect the fundamental electrochemical reactions which occur in the battery when it is charged or discharged.

"Use of Epsom salts and Glauber's salt

"Occasionally automotive batteries may need a supplementary charge from an external source of power. This is usually evidence of some maladjustment of the operating conditions. These 'charges' are naturally a source of inconvenience and may be misunderstood by the nontechnical public. Too often these compounds are advertised with claims that the necessity for such charges is eliminated. In any case the supplementary charge, amounting to 100 to 150 ampere hours, is emphasized, forgetting that the generator on the car supplies several thousand ampere hours to the battery in the course of a year. Advertising leaflets accompanying these compounds are usually careful to specify that the battery and the charging system on the car must be in mechanically good condition before using the material. If this were not so, the shortcomings of the panacea would speedily become apparent.

"It is, of course, possible that some material may eventually be found which would relieve the difficulties arising from abnormal operation of storage batteries, but none of the exploited materials which have been tested here have had any such merits.

"Compounds of Epsom salts and/or Glauber's salts and analogous materials under a seemingly endless variety of trade names, indicating their intended application to batteries, have come and gone without attaining any permanent acceptance by the public or the battery industry.

"Advertising claims

"Advertising leaflets which accompany these compounds often deal in generalities and make few specific claims the correctness of which could be determined without long and expensive tests. These claims usually include such statements as: (1) charges battery, (2) reduces sulfation, (3) lessens chance of buckled plates and decreases sludge, (4) increases useful life, (5) helps prevent freezing, (6) retains charge longer, and numerous other statements. Sometimes, simple 'practical tests' are described which may lead to false conclusions by those who are not familiar with the technical aspects of the subject. The ordinary user, of course, cannot compare the efficiencies of similar batteries treated with the material and others not so treated, nor can he determine whether the material extends the useful life of his battery. The usual treatment con-

sists of adding the material to the battery first then letting the motor run for about 20 minutes to one hour. As apparent proof of the merits of the material, the battery is 'run down' by stepping on the starter with the switch 'off' until the motor no longer turns over. The battery is then rested for a few minutes, turn the switch 'on' and step on the starter. The motor will start as indeed it should.

"This test relies upon the well known recuperative property of storage batteries. The normal battery at high rate discharge only uses a small part of its useful capacity. On standing a short time the battery appears to have regained this capacity, since it will again operate for a short time at high rates. Carefully controlled tests are necessary in order to determine these points definitely and none of these materials which have been tested here have produced any beneficial effect when added to the regular electrolyte. Some are definitely harmful.

"The best electrolyte is in the battery

"It is still evident that the best electrolyte for a storage battery is that presently used by the battery manufacturers since years of research and experience have shown no other materials superior to the customary sulfuric acid and electrolyte of proper specific gravity."

Use Voids Factory Guarantee.—Battery manufacturers generally sell their products with a standard warranty or guarantee against failure caused by manufacturing defects. This guarantee is voided, manufacturers informed NBBB, by the introduction of any battery dope into their batteries. The reason for this is that many battery compounds contain impurities which are definitely harmful to batteries. Naturally manufacturers decline any responsibility for damage caused by tinkering with the original electrolyte.

THE ELECTRIC STORAGE BATTERY CO.,
EXIDE BATTERIES,
San Francisco 24, Calif., January 9, 1950.

SILVA'S AUTO WRECKING CO.,
1510 University Ave., Berkeley, Calif.
(Attention: Mr. Ernest Silva.)

GENTLEMEN: Your letter of December 26th to our General Offices at Philadelphia has been referred to this office for reply.

In response to your inquiry, attached is a folder on "Battery Compounds and Solutions," issued by National Better Business Bureau, Inc., which we trust will answer your question.

Your very truly,

H. J. TOFT,
San Francisco Branch.

HJT:MS
Enc.—as indicated.

ATLAS SUPPLY CO.,
22 BATTERY STREET,
San Francisco 11, Calif., February 6, 1950.

MR. DAVID M. JACOBS,
Berkeley Grocery,
2476 Telegraph Ave., Berkeley 4, Calif.

DEAR MR. JACOBS: With reference to your letter of January 20, addressed to our Newark Office in regards to the use of a powder to increase the life and service of batteries.

For your information we are enclosing a copy of a circular prepared by the National Better Business Bureau regarding Battery Compounds and Solutions. This explains in detail the inadvisability of using additives other than electrolyte in batteries.

Very truly yours,

ATLAS SUPPLY COMPANY,
H. W. BOWERS,
West Coast Manager.

HWB lc

WILLARD STORAGE BATTERY CO.,
246–286 E. 131ST ST.,
Cleveland 1, Ohio, January 4, 1950.

SILVA'S AUTO WRECKING COMPANY,
1510 University Avenue, Berkeley, California.

(Attention: Mr. Ernest Silva.)

GENTLEMEN: We have had no information relative to the white powder called Battery AD–X2 and suggest that before using it you send us a sample and we will have it analyzed in our Chemical Laboratory and advise you whether or not it is satisfactory for use in your batteries.

From your letter it appears that this is one of the numerous storage-battery dopes which are merchandised from time to time and we call your attention to page 20 of the enclosed AABM Service Manual where you will find the subject "Battery Dopes" discussed thoroughly.

Very truly yours,

WILLARD STORAGE BATTERY COMPANY,
A. L. BLACKWELL,
National Service Manager.

ALB:AJ

The CHAIRMAN. We have heard the second call for a quorum; therefore, we will have to recess until 10 o'clock tomorrow morning. I understand we have this same room tomorrow morning.

Mr. Ritchie, you think you could finish in about 30 minutes, unless you are interrupted by quite a number of questions that might be asked of you?

Mr. RITCHIE. I believe that I could; yes, sir. I am terribly sorry I did not get through this morning. I thought I could do much better.

The CHAIRMAN. We are very sorry, too, but it was not entirely your fault because there were quite a number of interruptions by questions. We will resume tomorrow morning at 10 o'clock.

(Whereupon, at 12:15 p. m., the hearing was recessed, to reconvene at 10 a. m., Tuesday, June 23, 1953.)

BATTERY AD-X2

TUESDAY, JUNE 23, 1953

UNITED STATES SENATE,
SELECT COMMITTEE ON SMALL BUSINESS,
Washington, D. C.

The committee met, pursuant to adjournment, at 10:05 a. m., in the caucus room, Senate Office Building, Senator Edward J. Thye (chairman) presiding.

Present: Senators Thye (chairman), Ferguson, Hendrickson, Schoeppel, Sparkman, Gillette, Humphrey, Hunt, and Smathers.

Also present: Robert A. Forsythe, chief counsel; Blake O'Connor, professional staff member; and William D. Amis, investigator.

The CHAIRMAN. The committee will please come to order so that we can proceed with the hearing.

I hope this morning that we can refrain from asking the witness any questions until he has completed his statement. It will save time, and then after the statement has been completed, each and every one will be given an opportunity to ask as many questions as he likes.

With that, Mr. Ritchie, you may proceed, sir.

TESTIMONY OF JESS M. RITCHIE, PRESIDENT, PIONEERS, INC.—Resumed

Mr. RITCHIE. Yes, Senator Thye, due to the interruptions yesterday, Mrs. Ritchie and I worked all night last night, and I have prepared a condensation of my statement. It covers the exhibits briefly; and if I may I would like to read this as rapidly as possible into the record, and then answer any questions that might come up.

The CHAIRMAN. I realize, Mr. Ritchie, that if questions are constantly asked of a witness while he is endeavoring to make his statement, it does not do justice to the witness, because he cannot make his complete statement in such a manner that it is understandable when it is read.

For that reason, I was hoping this morning that it would not only expedite matters, but it would be in all justice to you that you proceed to carry right through. We will endeavor to do that with the other witnesses also. Then, after you have completed your statement, we will proceed with the interrogation, and everyone will have every opportunity to ask as many questions as he likes.

We have no timetable or any schedule, so you may proceed.

Mr. RITCHIE. Thank you, sir.

I mentioned yesterday that the potential of different metals was discovered by accident—that was galvanic potential. To keep the record straight, Dr. Planté of France seems to be the first man who

was successful in working with the lead-acid battery which we are at this time discussing. It might be of interest to note that there has been no major chemical change in the lead-acid battery since it was conceived by Dr. Planté up to the time that we developed Battery AD–X2.

We covered the period yesterday in a roundabout way from 1947 to August 1950, a period of time in which the product, Battery AD–X2, was condemned by Letter Circular 302 published in 1931, and distributed by the National Bureau of Standards and the National Better Business Bureau, even though they had not claimed that the National Bureau of Standards had tested the product.

I would like to insert a letter from Dr. Randall to the Director of the National Bureau of Standards of August 17, 1949, stating that the National Bureau of Standards had put first priority on sodium sulfate and magnesium sulfate, which was erroneous.

Then I would like to insert a letter addressed to K. B. Willson from Dr. Randall—Mr. Willson was formerly the operating manager of the National Better Business Bureau and is presently its president—pointing out that the National Bureau of Standards has admitted that they have never tested battery AD–X2, and that he considers it wrong for the National Better Business Bureau to condemn the product without benefit of test.

The CHAIRMAN. Mr. Ritchie, you are asking that those letters be inserted in the record?

Mr. RITCHIE. Yes, sir.

The CHAIRMAN. They will be inserted in the record.

(The documents referred to are as follows:)

RANDALL AND SONS,
CHEMICAL AND CHEMICAL ENGINEERING CONSULTATION,
2512 ETNA STREET,
Berkeley 4, Calif., August 17, 1949.

Re: File 1.8.

Dr. E. U. CONDON,
Director, National Bureau of Standards,
Washington 25, D. C.

DEAR DR. CONDON: I have had no reply to my letter of January 10, 1949, addressed to you, neither have I had any direct reply to my letters of July 27, 1948, and December 31, 1948, addressed to Dr. George W. Vinal of your Bureau. I wish to assure you that there was no thought of avoiding your office when I wrote to Dr. Vinal. My correspondence with Dr. Vinal was frank correspondence of one scientist with another. In a way, I sought to warn him of what was ahead. If protocol has been breached, please accept my humble apology. Personally, I feel aggrieved that I have been so ignored. Let me assure you that my comments are made in the interests of arriving at the truth without bias. You need have no hesitation about my sincerity. When the problems arising out of this AD–X2 (Protecto-Charge) matter were first presented to me, I was skeptical until I, myself, performed some key experiments, witnessed the condition of torn-down treated and untreated batteries, and talked with satisfied users who were in a position to know what they were talking about. I do not know all the answers, I am trying to find out. I wish to assure you that I am not being duped by my clients, Pioneers, Inc. and that they are making every effort to avoid undemonstrated statements.

Let me also assure you at the onset that the present management of Pioneers, Inc. is attempting in every way possible to conduct their business in accord with the best ethics of the National Better Business Bureau. During the past year, all their advertising matter and publicity has been checked by the Oakland and/or San Francisco Branches of the Better Business Bureau and their published testimonials have been verified by the Manager of the Oakland Bureau. Dr. Frederick G. Sawyer of the San Francisco Office of the Chemical and Engineering News has also verified a number of the testimonials.

Dr. Vinal evidently puts first priority upon the equivalence of magnesium and sodium sulfates dissolved in sulfuric acid and AD–X2 so dissolved. His conclusion is at first sight reasonable, and this was my first conclusion. However, I have made sufficient bench tests and I have seen the results of other bench tests run by competent engineers at McClelland field. I have seen many batteries condemned by manufacturers representatives and competent battery maintenance men as not capable of being rehabilitated by recommended methods of Dr. Vinal and the manufacturers, restored to satisfactory service (some for a period of 2 years now) with no other procedure than mechanical overhaul and treatment with AD–X2. These observations convince me that there is a real difference between a mixture of sodium and magnesium sulfates and the same salts which have been subjected to the treatment which results in AD–X2 powder. If Dr. Vinal will carefully consider these facts, I am sure that he too will arrive at the same conclusion as I.

Dr. Vinal's published articles indicate that there is no deleterious effect of sodium and magnesium sulfates. His statement is that there is no beneficial effect. Our experience, that of practical battery men with whom I have had many interviews, and statements in the literature all indicate that sodium and magnesium sulfates or their mixtures do have the property of alleviating "sulfation" but that excessive shedding of active material accompanies the remedy and the battery soon fails after a few weeks. This is the basis for rejection of the use of the many "h' 'ly advertised" products promoted by those who do not hesitate to use misleading claims, unauthorized and misleading testimonials, and "unethical methods" of conducting their business. For example, the "Duble-Power Chemical Co." recently used my name, without authorization, in a misleading fashion, indicating that I had endorsed their product.

I enclose (marked "A") a copy of a paper which I delivered before the Analytical Section of the American Chemical Society at the 1949 spring meeting in San Francisco, which discusses some of the theoretical aspects of the function of lead sulfate in the lead-acid battery.

It is evident that much work needs to be done to further define the exact way in which lead sulfate in the battery is converted into "sulfation." Some of this work may already exist in the secret files of the several battery companies.

I also enclose (marked "B") a copy of a bench test run by myself. This was indeed a very severe test, made to get a quick evaluation of AD–X2, and a mixture of sodium and magnesium sulfates. You will note that AD–X2 treatment was given the cell which appeared to be in the worst condition and no treatment to the cell in the best condition, at 7:30 a. m., June 24, 1948. Approximately 87 ah were put in and 30 taken out before treatment, 72 ah more were put in, making a net input of 139 ah. At the 300-ampere breakdown test of 8 p. m. June 24, 1948, the untreated cell reversed at the end of 16 minutes (80 ah out, or 67 percent rated capacity) while the AD–X2 cell still had a voltage of 1.65, and the salts treated cell 1.50 volts. The 300 ampere discharge so early after treatment is really too severe.

I also enclose a copy of a similar test (marked "C") by a reliable engineer at McClelland Field on August 25, 1948. Cell type III was treated with a mixture of 46 percent sodium sulfate and 54 percent epsom salts, type II with a 5 percent sodium sulfate and 95 percent epsom salts and the third cell with AD–X2. After 15 minutes at 300 ampere (75 AH) the AD–X2 cell was cooler and the voltage was the highest. After 86 additional ah discharge, 161 in all, the voltage of the AD–X2 cell was still 1.49 that of the salts treated cells having reversed and dropped to —0.38 volts. This was a 120 ah cell, condemned to junk out of an overseas Army vehicle. It had had an unknown number of cycles in a vehicle after treatment before this test, but was obviously in good condition.

An additional test (marked "D") on the same battery is shown. It was given 280 ah input and the output was 152.5 ah. Here again the AD–X2 additive shows its superiority over the salts. These are only two of a large number of similar tests which show definite proof of AD–X2 claims. This battery had had 5 months in a vehicle after treatment.

The above laboratory tests are in agreement with the field results. They are in direct opposition to those of the tests run at the New York Naval Shipyard, Brooklyn, N. Y., Report No. 5073 (NS–677–051) February 1949 in which emphasis was placed on the lack of response of 4 batteries which had been idle for 1 year after completion of a test (character not stated) and their negative plates were in a severely sulfated condition (20 percent of positive material had been shed).

No reports have ever shown AD–X2 to harm a battery. In view of the hundreds of junk batteries treated and sold by Pioneeers, Inc., and its authorized

dealers on a 12 month guarantee with negligible claims, and the testimonials of large intelligent users attesting very large direct item battery cost savings, it is silly to say that AD–X2 has no value. To claim that AD–X2 has no value is either to show extreme prejudice or undue influence on the part of those few battery manufacturers who make a profit from the sale of replacement batteries.

Pioneers, Inc., give no publicity to the United States Government tests. When batteries are treated with AD–X2 the remaining warranty or guarantee period is assumed by Pioneers, Inc., when dealing with the general public, and the user is fully protected. This product should not be confused with those referred to in Letter Circular 302, or in your letter mentioned in my first paragraph.

We plead fair, unbiased, and uninfluenced consideration by the National Bureau of Standards.

With kindest personal regards,

Very truly yours,

RANDALL & SONS,
MERLE RANDALL.

MR: gs.
Enclosures.
cc: Senator Knowland; National Better Business Bureau; Pioneers, Inc.

RANDALL AND SONS,
CHEMICAL AND CHEMICAL ENGINEERING CONSULTATION,
2512 ETNA STREET,
Berkeley 4, Calif., September 15, 1949.

Mr. K. B. WILLSON,
Operating Manager, National Better Business Bureau, Inc.,
Chrysler Building, New York 17, N. Y.

DEAR MR. WILLSON: Your new pamphlet "Battery Compounds and Solutions" is doing great mental and financial harm to my client, Pioneers, Inc., Manufacturers and Distributors of "Battery AD–X2." They follow a conservative marketing program and their product has met with overwhelming commercial success and acceptance by qualified battery users.

I enclose herewith a photostat of a highly significant affidavit by Ed Bender. He is a recognized authority on the maintenance of heavy-construction equipment. Among his many responsible positions were: Maintenance Superintendent, Hetch-Hetchy Dam and Pipe Line Construction; same on San Francisco-Oakland Bay Bridge construction; same on Guam for Morrison and Knudsen Construction Co., sea walls and jetties; same Conyes, large transportation and construction company; and Mechanical Superintendent for Bechtel International Corporation, American-Arabian Pipe Line construction. Neither he, nor any of the published endorsers of "Battery AD–X2" have any obligation to or interest in Pioneers, Inc.

You have based your attitude towards "Battery AD–X2" on the statement of the National Bureau of Standards, which admits that it has not tested "Battery AD–X2," because its chemical analysis is somewhat similar to that of previously tested materials. They have ignored not only definitely accepted facts as to the inhibition of aging or "sulfation" of lead sulfate, but also the effect of salts on overvoltage. They have also ignored the field results of competent disinterested observers with practical experience and adequate records.

Pioneers, Inc., customers are satisfied, the manufacturers of replacement batteries are not, for the very obvious reason that they have lost many sales, because the batteries treated with "Battery AD–X2" have remained in service beyond their expected life. To ignore the field results is highly dangerous and unfair.

The reputation of the National Better Business Bureau and that of the National Bureau of Standards is being definitely undermined by your circulation of the pamphlet "Battery Compounds and Solutions." The thousands of satisfied users of "Battery AD–X2" know that the statements in the pamphlet do not apply to the product which has saved them money.

The factory guarantee of the battery manufacturer is assumed by Pioneers, Inc., when they treat a battery. The manufacturer can hardly object to this. This pamphlet is being circulated by representatives of battery manufacturers to users of "Battery AD–X2," and to prospective customers, and when inquiries are made as to the use of the additive in batteries of their make. It is always implied, if not actually stated, that the contents of your pamphlet apply to "Battery AD–X2."

The least that the National Better Business Bureau can do in the face of the damage being done, and done in the past, is to admit that "Battery AD–X2" will do what it claims, and to print on your "Battery Compounds and Solutions," in RED in a prominent place a statement substantially as follows:

"The statements herein do not apply to 'Battery AD–X2.' The manufacturers of 'Battery AD–X2' assume the factory guarantee for batteries treated by them. Their material has met all claims made by them."

Your very truly,

RANDALL AND SONS,
MERLE RANDALL.

MR:ab
cc E. C. Crittenden, Acting Dir. B. St.
cc Senator Knowland.
cc Mr. Green, Mgr. Dir. Nat. BBB.
cc Jack Harris, Oakland BBB.
cc J. A. Horton, Fed. Trade Comm.
cc Ritchie.

Mr. RITCHIE. In fact, I believe, outside of one short statement here, these are all insertions; each statement is just a brief summary of what I am asking to insert.

The CHAIRMAN. Then each of the requests that you make we will not act on them specifically, but they will be inserted as and when you have completed your statement.

Mr. RITCHIE. Yes, sir.

The CHAIRMAN. It will just be made a part of the record.

Mr. RITCHIE. Thank you.

A letter and memo from Dr. Randall to the Director of the Bureau of Standards, Dr. E. U. Condon, dated November 10, 1949, pointing out that he is quoting our statements out of context, and confusing the issue, and that he is condemning the product without test.

(The letter and memo, dated November 10, 1949, are as follows:)

NOVEMBER 10, 1949.

Dr. E. U. CONDON,
Director, United States Department of Commerce,
National Bureau of Standards, Washington 25, D. C.

DEAR DR. CONDON: We wish to thank you for your letter of October 20. Enclosed is a detailed reply to the specific questions asked by your Bureau. We would be most happy to attempt to answer any other queries.

The true evaluation of any product is customer acceptance. Customer acceptance of battery AD–X2 points to better battery service and reduced first-item battery expense. Lowered battery costs are strongly reflected by all battery AD–X2 customers, who have detailed cost records available on their annual battery expenditures before and after the adoption of battery AD–2X. Better service is also reflected in the enthusiastic reception of the product, which is evidenced by repeat orders.

Obviously, battery AD–X2 does not charge a battery. It would not be true if we were to say that by the use of the product all "sulfation" is eliminated in a single charge. Our experience has shown that with battery AD–X2 and charging as outlined in paragraph 26, form 80, enough material is converted to allow a battery to function sufficiently for the generating system of the equipment in which it is used to complete the process in the normal day's work. In the most severe cases from 1 to 3 cycles, as outlined in paragraph 26, form 80, will be found to be effective. Our criticism of the cycling in the Government laboratories was that the cycling had been done on the modified life-cycle basis. It is the intention of Pioneers, Inc., to prolong the useful life of batteries, and we can find no evidence where the life-cycle type of cycling could possibly add to the life and usefulness of a battery so cycled.

Along this line I would like to compare your first quotation from my criticism of the various Government laboratories with what is actually stated in item 14, page 2, of form 80. You quote this paragraph, in part, as follows:

"When a 'sulfated' battery is treated with AD–X2, the 'sulfation' gradually lessens under the influence of cycling (charge and discharge) or use of the battery. * * *"

We quote the entire paragraph:

"WILL AD–X2 DISSOLVE 'SULFATION'? YES. When a 'sulfated' battery is treated with AD–X2, the 'sulfation' gradually lessens under the influence of cycling (charge and discharge) or use of the battery. The hardened 'sulfate' is slowly converted into soft active material in firm contact with the grid."

We bring your attention to paragraph 27, Form 80, beginning in the center of the fourth line:

"do not first attempt to charge cells then treat as prolonged charging on badly sulfated plates prior to treatment corrodes the positive grid."

You quote as follows a statement by Mr. Ritchie from his letter to the Navy Department and Signal Corps, dated August 17, 1949:

"Any battery can be desulfated by cycling (charge and discharge) without the use of "Battery AD–X2" providing it is mechanically sound and put through enough cycles."

The statement by Mr. Ritchie reads in full:

"Any battery can be desulfated by cycling (charge and discharge) providing it is mechanically sound and is put through enough cycles. If the battery is badly sulfated this will be at the expense of the grid through (1) corrosion of the grid, (2) conversion of the grid to lead peroxide in the positive plate, etc."

In other words, completely ruining a battery which, if mechanically sound and treated with "Battery AD–X2" in accordance with Form 80, could be expected to give many months of useful service.

You also refer to item 10, page 2, of Form 80 which reads:

"Can 'sulfation,' be removed from a battery by an electrical charge? 'Sulfation,' if not too severe can be transformed to active material, *to some degree* at least by a series of charges and discharges."

It is obvious from the foregoing quotations that the paragraphs referred to in your letter should be considered in their entirety and not in part. If this is done, there should be no confusion as stated in the last paragraph of your letter.

As to the Navy Test, we find it very difficult to understand why the batteries were given a charge of over 500 percent prior to treatment for test purposes, when it is directly contrary to all instructions put out by Pioneers, Inc. We call your attention to paragraph 27, page 3, of Form 80.

We have further difficulty in understanding the expenditure of money by the Navy on a test of such abused batteries that it could not possibly be of benefit to anyone.

We agree that a product should stand on its own merits. We submit that the evidence of merit as furnished by the original affidavits from customers not financially interested in Pioneers, Inc., but who are seeking better battery service at less cost, is overwhelming.

Pioneers, Inc. have had numerous instances of wholehearted acceptance of "Battery AD–X2" by men at usage level, only to be turned down at the higher levels and without explanation. Here Circular Letter 302 and your letter of March 1949 published by the National Better Business Bureau, are no doubt factors. Yet, men who know the product and see the service of the treated batteries and who get credit for lowered battery expense, "raise their eyebrows," when these two documents are mentioned.

I understand some Government tests are quite favorable. The McClellan Field Test is the only fragment of such favorable test I have been able to see and study.

Sincerely,

MERLE RANDALL.

MR:ab

cc: Senator William F. Knowland.

cc: Mr. K. B. Willson, National Better Business Bureau.

NOVEMBER 10, 1949.

File 1.8/1102c

Dr. E. U. CONDON,

Director, U. S. Department of Commerce,

National Bureau of Standards, Washington 25, D. C.

Subject: Reply to Memorandum on AD–X2.

1. When the "Standard Test for Additives for Storage Batteries" was proposed on May 20, 1948, we were still influenced by the tradition of the "Life Cycle Test," We were then unaware of the tremendous influence of aging as a factor in battery performance in the field. While our experience with the May 20, 1948,

test is positive in showing a favorable response of sulfated cells to treatment with Battery AD–X2 (see exhibit marked "F"), it was found that it provided for too early application of continued discharge rates before the cell had had sufficient usage.

It is obvious that it will require some exercise before the active material can be converted into the unaged variety, especially if this has been accompanied with the development of the larger crystals of lead sulfate. (See paragraphs 23 and 26 of Form 80.)

We had made an intensive study of the corrosion of lead anodes in hot sulfuric acid in connection with an entirely different matter, and had found the tremendous corrosive effect of discharge of oxygen in acid solutions.

The effort often made to restore a "sulfated cell" by prolonged overcharge results not only in excessive shedding but also in excessive corrosion of the positive grid, bringing antimony into solution, and converting the protective skin of lead peroxide on the positive grid to active material, thus shortening the life of the grid. In formulating the "test of May 20, 1948," the importance of this factor had also not been realized.

Since the formulation of the May 20, 1948, test we have talked with representatives of the battery industry and find that all those with whom we talked as well as Harner (cited page 4 in letter of Sept. 28, 1949) see little correlation between the results of the "Life Cycle" test and the life performance of a battery in automobile service.

The principal shortcoming of our May 20, 1948, test is that it does not provide for standing in discharged condition for a sufficient time. Making the test at 110° F. or even higher might be a valid method of shortening the time in the discharged condition between cycles.

We are frank to admit that we are as yet not able to propose a laboratory test, which can be made in a reasonable time, and simulate the excellent results that customers have achieved in the field.

I am sure that you must agree that demonstrated service is the final criterion of value. What I tried to say was that no present laboratory test parallels the performance of batteries treated with "Battery AD–X2." I gave ample evidence that the "Life Cycle Test" is of very doubtful validity for determining the probable life of SLI batteries as actually used.

I enclose marked Exhibit "R," a new tentative test for additives which avoids some of the pitfalls of my May 20, 1948, test.

I regard the part relating to measurement and analysis of the ratio of gases to charging current as important.

We are now working on a measurement with rotameters of the amount of gas produced and its composition. If the indications of higher overvoltage in the presence of the additive are correct, then the additive should show relatively less gas (more active material converted). This is the only way we can account for the observation of relatively less water lost from the cell on use. (See Bender affidavit.) A better laboratory test is a challenge.

Paragraph 14 of the leaflet is still valid. It does require exercise of the plates in severe cases to effect the conversion of "sulfation." See paragraphs 26 and 27 of Form 80.

2. It is only possible to achieve the ideal operation outlined by constant attention, as in a large central telephone installation. The automobile battery, as used, certainly does not approach this ideal. Automobile service is hardly "floating," as there are many periods of drain not closely followed by charging. "Battery AD–X2" has not as yet been shown to be harmful in any way, and certainly the theoretical and practical reasons for the use of an additive in slowing the aging are clear. The further the operating history of the battery departs from the ideal outlined, the greater is the need for the "medicine." Savings in operation by users is sufficient reason. (See Bender affidavit.) An additive (lithium hydroxide) is used in the Edison Battery. Additives or expanders are used in forming plates for lead-acid batteries.

3. By reducing the rate of aging, shrinkage from the grid, etc., in new batteries the money savings possible are greater than with batteries which had a part of their life wasted to a point of discard. Because previous additives had a tendency to shed the active material, it was the practice of the promoters to focus their sales effort on the "sulfated" battery, get a quick sale, and then disappear. Additives of the sodium-magnesium sulfate type, do have the property of enabling one to put a charge in a "resistant" battery. This is spectacular enough to effect immediate sale. While a large part of Pioneers, Inc., business is the restoration (with guarantee) of batteries which have been condemned

by dealers and manufacturers' representatives, it is our firm belief based upon the experience of customers who have made thousands of treatments of new batteries, that a universal usage of "Battery AD–X2" in new batteries would largely reduce the battery replacement business, with a great saving of lead to the Nation, and expense to everyone concerned. One must remember in this connection, however, that the cost of treatment with "Battery AD–X2" is normally recovered by less than two months extension of the life of the battery.

There are thousands of junked batteries treated with "Battery AD–X2" in service 12 to 24 months after treatment. It is still true that some time in test may be saved by starting with already "sulfated" and/or abused batteries.

4. The Allen tester used is no longer manufactured. It consisted of an adjustable carbon block rheostat capable of taking 300 amperes continuously at 6 volts (considerable heating), an ammeter in series, and three voltmeters each connected to one of the three cells of the battery under test.

Enclosure A is a copy of the paper "Aging of Lead Sulfate."

The enclosure, test B, was made with the above Allen tester.

Enclosure C and D were made by the personnel of McClellan Field Air Base, who used their own equipment.

Enclosure H to N are affidavits.

Tests of enclosure C were made on the above Allen tester.

5. In The Test of the Aerolite Battery (Enclosure B) the only instances of a recorded drop in voltage on reducing the current are on page 5, treated cell after drain of 77.5 ampere hours at 300 amp. The voltage was 1.72 for the treated cell, and after an additional one-half minute at 200 amperes it was 1.65 volts, which was 0.20 volts higher than that of the untreated cell (positive cell). (Note that after 1½ minutes at 200 amperes and 1 minute at 100 amperes its voltage was back to 1.80. (Note that over 80 ampere hours at 300 ampere rate was taken out of a 120 ampere (20-hour rating) cell.)

On a later run of the same test, page 6, July 1, 1948, 190 ampere-hours had been taken out of the treated cell at 300 ampere rate to 1.65 volts (165 ampere-hours to 1.75 volts "Battery AD–X2" treated cell, 0.50 volts untreated cell) and after 4 minutes at 200 amperes the voltage was 1.60, which probably meant that there was a slight rise immediately the current was reduced.

In all other cases recorded there was a rise in voltage when the current drain was reduced.

In Enclosure C (Test at McClellan Field) the line "427/160" evidently represents the open voltage of 1.91 volts after finish of the drain at 160 amperes rather than the drain voltage. The voltage 1.71 at 120 ampere drain is higher than the finish of 1.56 volts at 200 ampere drain. Note untreated cell is reversed at time 4:25.

In Enclosure D, after 20 minutes drain at 300 ampere rate (110 amp. hours), the voltage was 1.56, and with a continued drain for 2 minutes the voltage was 1.53 volts. If the change of drain was made near 2.43, the voltage was then probably less than 1.50 (from the rate of fall at the time the change was made).

We have observed a rather significant difference in the recovery of treated and untreated cells which have been drained to exhaustion of voltage, allowed to rest, and exhausted again, several times. The total ampere hours out of the treated cell is greater, but the recovery is slower, indicating that the active material has been used up to a greater extent in the treated cell. The capacity of a treated "sulfated" cell repeatedly drained to exhaustion seems to increase with each charge. This is just what would be expected of active material with a maximum surface.

6. I enclose (Exhibit S) a letter from Mr. Ritchie, of Pioneers, Inc., giving instructions to one of his service dealers for the handling of "junk batteries." These directions are just what an experienced battery man would do, except that the use of a long equalizing charge is omitted as the use of an equalizing charge on badly sulfated batteries tends to corrode the positive grid. Pioneers, Inc., do not sell "Battery AD–X2" for indiscriminate use by the inexperienced general public.

b. The Aerolite battery had been filled with 1,000 sp. gr. acid by the manufacturer. The sp. gr. of the acid used with an "air dry" battery depends upon the experience of the operator so as to bring the battery to 1.280 when fully charged.

c. For test purposes this is covered in Exhibit R. For commercial batteries still operating in vehicles we believe it is economical (see affidavits) to treat all batteries in the fleet. For "junk" and "shelf sulfated" batteries this is covered in Exhibit S. Mostly with shelf sulfated new batteries it is economical to adjust the fluid level and treat without further examination.

7. Fig. 58, page 207, Vinal shows that the 300 ampere rate capacity is about 0.40 that of the 20-hour rate capacity. 5.6 amperes per plate at 24 minutes (300 ampere rate) or 14.2 amperes per plate at 20 hours (6 ampere rate). There is a mistype somewhere. Anyway, 105 ampere-hours at the 300 ampere rate is about the same as an exterpolated 260-hour capacity at the 20-hour rate. Another way of stating this is that we would expect only 48 ampere-hours at 300 amperes from this 120 ampere-hour battery as rated at 6 ampere or 20-hour rate, whereas we got 105 ampere-hours.

MERLE RANDALL.

Mr. RITCHIE. A patent owned by George Wood Vinal, Chief, Electrochemistry Section, National Bureau of Standards; applied for May 1945, issued June 20, 1950; making some of the same claims on extending the life of batteries and diminishing shedding that we make for battery AD–X2; using magnesium sulfate to get porosity in his separators while we use battery AD–X2 to assist in maintaining porosity in the plates. Shop rights given to the Government, but patent owned by Dr. Vinal.

(The document above referred to is as follows:)

June 20, 1950 G. W. VINAL 2,511,887

BATTERY SEPARATOR

Filed May 25, 1945

FIG. 1

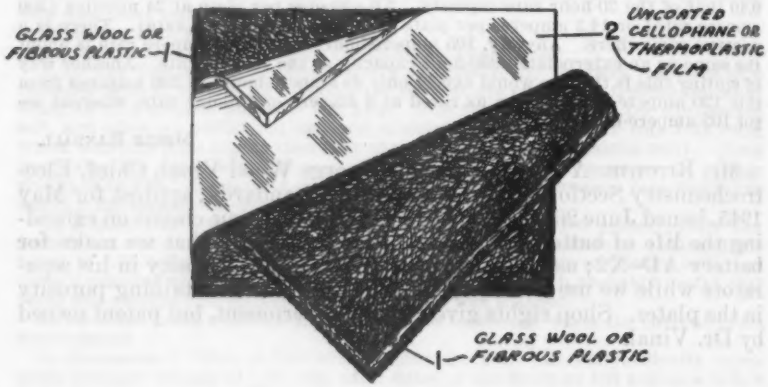

FIG. 2

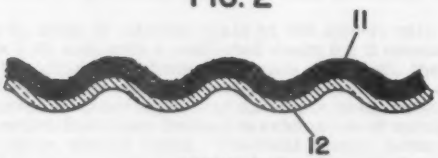

FIG. 3

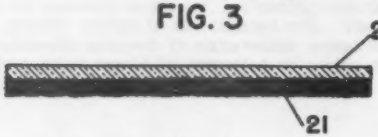

FIG. 4

Inventor

GEORGE WOOD VINAL

By Ralph L. Chappell

Attorney

Patented June 20, 1950 2,511,887

UNITED STATES PATENT OFFICE

2,511,887

BATTERY SEPARATOR

George W. Vinal, Washington, D. C.

Application May 25, 1945, Serial No. 595,864

2 Claims. (Cl. 136—145)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

This invention is concerned with electrolytic diaphragms, more particularly with separators used in secondary cells.

Diaphragms, usually called separators in the battery art, are placed between alternating positive and negative electrodes of electrical cells. Primarily, the necessity for these separators is to prevent adjacent electrodes from coming into contact with each other, thus creating an internal short circuit which is ruinous to cell operation.

A second reason for the use of separators is to prevent the growth of "trees" which can reach from electrode to electrode and create an effective current bridge. Still another reason is to support and retain active material of the plates in its proper and useful place.

Further, separators space the electrodes and thereby provide an adequate amount of electrolyte volume between plates.

Batteries charged and dry, ready to provide current merely on addition of electrolyte, are substantially a necessity in many military situations. They should be dry for transportation purposes, and charged so that they may be readied for service with the least manipulating and in the least time possible.

Thus, there is established the demand for a battery separator which will:

(1) Be made of available materials;

(2) Constitute an adequate diaphragm, separator, and spacer between plates of opposite polarity in storage batteries;

(3) Permit adequate electrolytic conduction and prevent metallic conduction;

(4) Be capable of being stored in the dry condition without impairment of quality.

It is, accordingly, an object of my invention to provide such a diaphragm having all the needed properties and qualities.

More specifically, it is an object of my invention to provide novel battery separators which constitute complete and adequate diaphragms and spacers for wet cells, are not liable to spoilage due to dry storage, will stand up under charge and discharge, will give long battery life on shelf and in service, and will be easily made from available materials.

Other objects and advantages of my invention will be in part referred to herein and in part obvious from the following disclosure.

Fig. 1 illustrates a preferred embodiment of my invention, and is a cross section.

Fig. 2 is a further illustration of the form shown in Fig. 1.

Fig. 3 shows a slightly different separator, and

Fig. 4 indicates still a third form of separator in accordance with my invention.

Broadly, my invention resides in the discovery that plastic films naturally permeable or electrolytically conducting or which may be made so may be used advantageously as battery separators in combination with other materials.

Referring to Figs. 1 and 2, there will be seen a preferred form of my new separator, consisting in this instance of two mats of glass floss 1, between which is placed a plastic film 2.

I have determined the usefulness of films formed from thermoplastic materials, for example, polyvinyl alcohol, polyvinyl acetate, methyl cellulose, carboxymethyl cellulose, polyvinyl butyral, ethyl cellulose, polystyrene, and various forms of nylon. Certain of the materials are not naturally permeable in film form, but may be made so, as by incorporating a soluble salt or a plasticizer subsequently leached out of the film. In order to make porous films of either ethyl cellulose or polystyrene which are not naturally permeable in film form, potassium sulfate or magnesium sulfate is incorporated therein as these salts may be readily leached out of the film. A plasticizer for producing the same result in ethyl cellulose is hydrogenated methyl abietate, known by the trade name of "Hercolyn," which can be removed by an organic solvent.

Glass floss is an eminently suitable material for the fibrous mat. Other fibrous materials of like physical form, such as a fibrous plastic, may be used. Polystyrene floss is an example of fibrous plastic which is compressible into thin sheets when subjected to heat.

Physically, the permeable film 2 may be used with two fibrous mats 1, as indicated in Figs. 1 and 2. Without attaining all the advantages of that construction, only one mat may be used, this being illustrated in Figs. 3 and 4. Fig. 3 further suggests a corrugated construction which may be employed in any case, while Fig. 4 is intended to indicate a more or less secure bond between the glass mat and the plastic film, which may be advantageous, say for purpose of ease of assembly with the plates when making up the cell. In Fig. 3, 11 refers to the glass mat, 12 to the film. In Fig. 4 the glass mat 21 is bonded to film 22. A suitable bonding agent is formaldehyde or its compounds which will bind with the plastic film when heat and pressure is applied.

The preferred construction shown in Figs. 1 and 2, however, attains all the advantages possible. The two glass floss mats are excellent for retaining the active material on the electrodes, while at the same time their porous structure accommodates large amounts of electrolyte and allows adequate circulation. The mats act as supports for each side of the fragile plastic film, which thereby may be extremely thin. This feature is of value in permitting high drain, though in batteries designed for low drain thicker films are satisfactory. The sheets may be bonded, as suggested in Figure 4.

The plastic film used must be water permeable and electrolytically but not electronically conductive. The film also must allow the flow of current, and must be little affected by the electrolyte employed. Other materials than those I have named, but having the qualities referred to, will be found useful.

Any of the forms described will be unharmed by dry storage and will consequently be adapted for the manufacture of dry charged batteries. All will prevent treeing.

The invention herein described and claimed may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. A battery separator comprising at least two members, one being a sheet of fibrous glass floss and a second being a thin film of regenerated cellulose.

2. A battery separator consisting of glass floss mats bonded on each side of a regenerated cellulose film.

GEORGE W. VINAL.

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(The document above referred to is as follows:)

July 4, 1950 I. A. DENISON ET AL 2,513,292

ALKALINE PRIMARY BATTERY AND ELECTROLYTE THEREFOR

Filed Oct. 17, 1945

FIG. 1

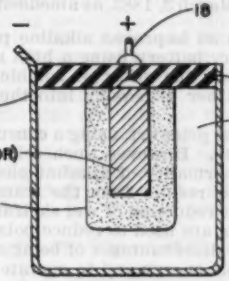


FIG. 2

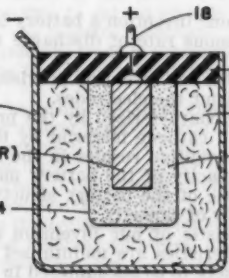
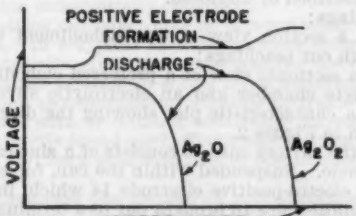


FIG. 3



Inventors
IRVING A. DENISON
PAUL L. HOWARD

By Ralph L. Chappell
Attorney

Patented July 4, 1950 2,513,292

UNITED STATES PATENT OFFICE

2,513,292

Alkaline Primary Battery and Electrolyte Therefor

Irving A. Denison, Silver Spring, Md., and Paul L. Howard, Arlington, Va.

Application October 17, 1945, Serial No. 622,920

4 Claims. (Cl. 136—106)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

Our invention relates to an improved alkaline primary battery. More specifically we disclose a primary battery using a high normality alkaline electrolyte with an agent to counteract the effect of soluble ionic and colloidal positive electrode particles from either dispersing into the electrolyte or depositing on the negative electrode.

Batteries are known in the prior art, using a consumable zinc electrode together with an alkaline electrolyte. However, such cells have suffered from the disadvantage that increased normality of alkaline electrolytes results in increased corrosion of the zinc. This results from the transferring of positive particles to the zinc causing a further reduction of wet shelf life particularly where readily reducible positive electrodes are used to reduce polarization. Prior art batteries have also suffered from the disadvantages of being able to produce only a portion of the theoretically available energy and to operate at reduced efficiency at both low and elevated temperatures.

In accordance with our invention an alkaline electrolyte with an added agent is disclosed which effectively increases the wet shelf life of an alkaline primary battery.

Also in accordance with our invention a battery is produced having the ability to withstand a high continuous rate of discharge without appreciable decrease in voltage.

Further in accordance with our invention provision is made for restricting the circulation of electrolyte about the electrodes.

Our invention is further characterized by the provision of means to prevent the dissolving of anode and cathode material by the electrolyte.

Another feature of our invention resides in the fact that an extremely large share of the theoretical capacity of the battery may be utilized.

Still another characteristic of the battery structure which we disclose is the light weight per ampere hour of capacity.

A still further characteristic of our invention resides in the fact that the desirable discharge characteristics are maintained in spite of operation at the extremes of temperature likely to be encountered in use.

Our invention also resides in features of construction, combination and arrangement herein described or disclosed.

In the drawings:

Figure 1 is a section view of one embodiment of a battery constructed in accordance with our teachings;

Figure 2 is a sectional view of a preferred embodiment using a filler material in the electrolyte chamber and an electrolytic silver peroxide anode.

Figure 3 is a characteristic plot showing the discharge curve of a battery of the type shown in Figure 2.

In Figure 1 the battery case 10 consists of a zinc can which serves as the outer negative electrode. Suspended within the can, for example, by means of insulation 12, is the electro-positive electrode 14 which, in our preferred embodiment, may have a metallic core 16 brought out to a terminal 18. The space 22 between the electrodes is occupied by the electrolyte which preferably consists of sodium hydroxide together with certain buffering compounds which will be described in detail below.

Figure 2 shows structure similar to that in Figure 1 except for the addition of filler material 24 which preferably consists of nylon, polystyrene, chopped asbestos or similar inert material. In this embodiment the active positive electrode consists of an electrolytic silver peroxide body 20 of the formula Ag_2O_2.

Many primary battery applications require a high discharge rate at a substantially constant voltage and a slow rate of deterioration upon standing in the wet condition during a period of storage or dormancy. Such applications are par-

ticularly numerous in military and naval equipment where light weight and dependability after a period of storage are of paramount importance.

In order to prevent corrosion during storage, various means have been devised for releasing the electrolyte immediately prior to use. This has been accomplished, for example, by the breakage of a breakable glass container or diaphragm. The use of such batteries, however, is accompanied by the disadvantage that a mechanical force is required to accomplish the release of the electrolyte and further that corrosion takes place at a high rate during the dormancy period between periods of intermittent heavy discharge. Further, such batteries cannot be made of optimum size since separate provisions must be made for the storage of the electrolyte out of contact with the electrode.

An inherent requirement of a battery having a high discharge rate is an active negative electrode and a plentiful supply of ions in the electrolyte. The use of zinc, zinc alloy or zinc containing material as the consumable negative electrode is desirable since zinc is a fairly active metal and is both inexpensive and widely used in battery manufacture. Because of the high ionic dissociation of sodium hydroxide, potassium hydroxide and similar alkali metal hydroxides, water solutions of these compounds are normally considered satisfactory electrolytes. To produce a workable battery the zinc and alkaline hydroxide require in addition an electrode electropositive to zinc and a supply of oxygen to prevent polarization of the cell. For example, we have found that electrolytic silver peroxide is accompanied by certain novel advantages when used as the positive electrode. The equation of the reaction taking place at the electrolytically formed silver peroxide electrode is as follows:

$$AgO+2H^{+}+2e \rightarrow Ag+H_2O$$

As stated above the use of a concentration of the hydroxide electrolyte sufficiently great to enable a high discharge rate seriously corrodes the zinc electrode. In this case the zinc is dissolved by the solution, entering the solution as zinc hydroxide. The corrosion of the zinc electrode is aggravated by any impurity in or on the zinc tending to set up electric couples thereby producing local action. In the case of the positive electrode, it has been found that, for example, where a silver peroxide electrode is used both silver peroxide and silver oxide enter the solution in the ionic and colloidal state; however, this solubility is small.

The zinc electrode cannot be protected from these silver ionic and colloidal particles in the electrolyte by conventional separators or special semipermeable films because of the minute particle size. As previously stated it is necessary to prevent the transference of such particles in order to maintain the zinc electrode free from undue corrosion. Thus it is necessary to have an electrolyte compound of the proper hydroxyl ion concentration plus an additional ingredient which has the property of collecting the colloidal and ionic silver into conglomerates of such a size that a separating medium as stated above is effective in stopping any deposit of positive electrode material, for example, silver, on the zinc electrode. Such an ingredient is herein termed a "salting out" medium and the action a "salting out" effect. In addition, these materials act as buffers in maintaining the hydroxyl ion concentration substantially constant.

We have found that the salting out effect may be accomplished with a number of materials to be described. In a typical application satisfactory results have been attained with an electrolytic silver peroxide positive electrode and zinc negative electrode in an alkaline medium to which these materials are added in varying amounts. In addition to conventional alkaline hydroxides, water solutions of alkali metal ethylates with or without additional ingredients disclosed below are effective. The materials found most effective as "salting out" materials are the alkali metal zincates and boric acid solutions of alkaline hydroxides forming the alkali metal borate.

The following examples illustrate the method of preparation of the "salting out" buffering solutions mentioned. It will be understood that any alkali metal hydroxide may be used in such preparation without appreciably affecting the "salting out" and buffering action.

Example 1.—Potassium ethylate

Potassium ethylate was prepared from potassium hydroxide and ethyl alcohol combined in molecular proportions with the addition of a small amount of water to facilitate solution of the hydroxide. The reaction proceeds according to the equation

$$C_2H_5OH+KOH \rightarrow C_2H_5OK+H_2O$$

The solution was refluxed for several hours and evaporated to a pasty condition to form the potassium ethylate used in making up the electrolyte. Sodium hydroxide may be substituted for potassium hydroxide if desired. A satisfactory electrolyte was formed using 30% to 60% of the alkali ethylate in water solution alone. It was found that the addition of from 3% to 35% zinc oxide or from 7% to 35% boric acid increased the salting out effect.

Example 2.—Sodium hydroxide—sodium zincate solution

A solution of sodium zincate in sodium hydroxide was prepared in the following manner: Zinc hydroxide prepared by precipitation from zinc chloride by ammonium hydroxide was shaken for 12 hours with a solution containing an equivalent amount of sodium hydroxide to react according to the equation

$$Zn(OH)_2+2NaOH \rightarrow Na_2ZNO_2+2H_2O$$

After warming on the water bath for two hours, the solution was filtered. Equal parts of the filtrate and water by volume were added to a 14 normal sodium hydroxide solution in such proportions to produce a solution with a pH value of 9.8.

Satisfactory sodium zincate solutions were formed in accordance with the above reaction using from 10 to 50% of sodium hydroxide with 3% to 35% zinc hydroxide. If potassium hydroxide (10% to 50%) is used in place of the sodium hydroxide, the range for zinc hydroxide is 1% to 5%.

Example 3.—Sodium hydroxide—boric acid solution

With the object of preparing buffered solution of sodium hydroxide having relatively low pH value, various amounts of boric acid were dissolved in 25 milliliter portions of 14 normal sodium hydroxide. The reaction is believed to proceed as follows:

$$H_3BO_3+3NaOH \rightarrow Na_3BO_3+3H_2O$$

or

$$H_3BO_3+NaOH \quad NaBO_2+2H_2O$$

A solution consisting of 1.87 grams of boric acid in 25 milliliters of 14 normal sodium hydroxide solution resulted in a pH value of 9.25.

It was found that an electrolyte may be formed in accordance with the above reaction using from 10% to 50% alkali metal hydroxide with 7% to 35% boric acid.

The use of a buffer is known in the art in connection with other chemical reactions, especially those encountered in qualitative and quantitative analysis. Upon depletion of the hydroxyl ions during the use of the battery, additional hydroxyl ions are supplied by the hydrolysis of the potassium ethylate, sodium zincate or sodium borate in the three examples given. This maintains a constant concentration of hydroxyl ions. The salting out materials act both as a buffering agent and also to accomplish the salting out of silver ions and colloidal particles.

While the use of a salting out solution results in a marked decrease of electrode deterioration, further improvement can be obtained by the use of a filler material to prevent free circulation of the electrolyte. In the case of the negative zinc electrode, reduction of circulation results in the holding of zinc ions near the electrode thereby causing an increase of zinc hydroxide in solution to the extent that formation of further zinc ions is inhibited. This enables relatively high hydroxyl ion concentration to be used without excessive corrosion of the zinc. We have found that asbestos in the chopped or fibrous form, nylon fiber, polystyrene fiber, or similar inert materials allowing the passage of ionic current but inhibiting circulation and migration of the coagulated colloidal particles are satisfactory filler materials. The material should preferably have no chemical reducing effect on the positive electrode.

As previously stated in the above example we have found that electrolytic silver peroxide is extremely suitable as a positive electrode material, particularly because of its readily reducible nature. The chemical reaction taking place in the cell using electrolytic silver peroxide and zinc electrodes is probably expressed by the following reactions:

$$Zn+2NaOH+Ag_2O_2 \rightarrow Na_2ZnO_2+H_2O+Ag_2O$$

$$Zn+2NaOH+Ag_2O \rightarrow Na_2ZnO_2+H_2O+2Ag$$

The suitability of silver peroxide as a positive electrode material has been found to be somewhat dependent on the method of formation. It has been found that desirable characteristics are obtained when the silver peroxide is formed electrolytically from a pure silver electrode. The process of formation using the silver electrode as the positive pole is believed to take place in two steps; first, the production of silver oxide, secondly, the production of the peroxide from the oxide. This is indicated by the formation curve shown in Figure 3. It is believed that the rises in voltage during formation are respectively due to the complete formation of silver oxide from silver, and the complete conversion of the lower oxide to the peroxide form.

Satisfactory positive electrodes have also been produced by applying silver oxide in paste form on a metallic screen or other backing, reducing to silver either electrolytically or by means of a flame, and oxidizing electrolytically to the silver peroxide as discussed above. Electrolytic formation is believed advantageous because of the spongy texture of the peroxide formed. Other means of forming the silver peroxide positive electrodes will appear to those skilled in the art. For example, silver peroxynitrate of the formula Ag_2NO_4 may be used as a starting material and reduced by some means, for example the application of hot water, to form silver peroxide. However, such chemical methods do not produce a low resistance electrode comparable to that produced electrolytically.

The desirability of using a filler material to inhibit the corrosion of the negative electrode has been discussed; however, we have found that filler material utilized in accordance with our teachings can also be used to greatly reduce corrosion of the positive electrode. The high concentration of sodium hydroxide tends to attack the silver peroxide positive electrode for two reasons: first, because of the solubility of both silver oxide and silver peroxide in strong concentrations of sodium hydroxide; secondly, because high hydroxyl ion concentration encourages the dispersion of silver oxide and silver peroxide from the parent mass in colloidal form. Such colloidal material unless impeded gradually drifts to the zinc electrode where it combines with the zinc to aggravate the corrosion at the negative electrode. Various types of cellulosic materials were investigated in order to produce a barrier pervious to ions but which would impede colloidal particles. It was found however that the use of cellulosic materials was not desirable since the barrier material acted as a reducing agent, reducing the silver oxides to metallic silver and thus adversely affecting the positive electrode.

Thus it is seen that the use of a salting out material aids in reducing the colloidal drift since as indicated by our studies, the acid ion causes the aggregation of the colloidal particles to particles of such a size that the migration is more easily inhibited by the filler material.

Both sodium hydroxide and potassium hydroxide have been mentioned above as a plentiful source of hydroxyl ions. However, in our preferred embodiment, we have used sodium hydroxide since the zincate formed at the time of discharge is more soluble in sodium hydroxide than potassium hydroxide. Stated another way sufficient zincate can be added to the battery initially to serve as an effective buffer without approaching the saturation point. Thus as the zincate is formed during the discharge it will be soluble and not cause a lowering of battery capacity. If potassium hydroxide is used with a zincate buffer it is necessary to use a practically saturated solution of zincate to obtain sufficient buffering action. Thus zincate entering the solution as a result of discharge will reach saturation and start to precipitate early in the discharge. Such precipitation reduces the effective plate area available for discharge.

In Figure 3 two typical discharge characteristic curves are given. It will be seen that either a silver oxide or an electrolytic silver peroxide positive electrode results in a practically constant voltage discharge curve. The advisability of using an electrolytic silver peroxide is indicated graphically by the fact that the area under the silver peroxide curve is more than 50 percent greater than that under the silver oxide curve, indicating a greatly increased energy output where an electrolytic silver peroxide is used. No break in the discharge curve occurs as the peroxide changes to the simple oxide form. We have found that a slow electrolytic formation of the silver peroxide anode causes increased available energy for a given weight of battery material.

It will be seen from the above that we have produced a battery having distinct advantages over batteries used in the prior art, particularly with regard to shelf life, sustained voltage during high rates of discharge, and available energy per unit weight. We have shown a specific mechanical construction in Figures 1 and 2; however, it will be obvious to one skilled in the art that batteries constructed according to our teachings may take any desired structural form without appre-

ciable effect on electrical output. While we have shown and described particular embodiments of our invention, it will occur to those skilled in the art that various changes and modifications can be made both chemically and mechanically without departing from our invention and we therefore aim in the appended claims to cover all such changes and modifications that follow in the true spirit and scope of our invention.

The invention described herein may be made and used by or for the Government of the United States for governmental purposes without the payment to us of any royalties thereon or therefor.

What we claim is:

1. An electric battery comprising a zinc negative electrode, a silver peroxide positive electrode, an electrolyte comprising sodium hydroxide and a salting out material consisting of an alkali metal ethylate soluble in said sodium hydroxide solution.

2. An electric battery comprising a zinc negative electrode, an electropositive electrode and an electrolyte including an alkali metal ethylate in water solution.

3. An electric battery comprising a zinc negative electrode, an electropositive electrode, and an electrolyte consisting of 30 to 60% alkali metal ethylate, 3 to 35% zinc oxide and the remainder water.

4. An electric battery comprising a zinc negative electrode, an electropositive electrode, and an electrolyte consisting of 30 to 60% alkali metal ethylate, 7 to 35% boric acid and the remainder water.

IRVING A. DENISON.
PAUL L. HOWARD.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
458,424	Lugo	Aug. 25, 1891
692,298	Jungner	Feb. 4, 1902
793,078	Hubbell	June 27, 1905
1,624,845	Nyberg	Apr. 12, 1927
1,675,828	Siegmund	July 3, 1928
2,018,563	Martus	Oct. 22, 1935
2,422,045	Ruben	June 10, 1947

FOREIGN PATENTS

Number	Country	Date
16,471	Great Britain	or 1915
335,587	Great Britain	Sept. 29, 1930
95,423	Switzerland	July 1, 1922

OTHER REFERENCES

Vinal et al., Circular No. 79, Bur. Stds. (1923), page 7.
Denison, L. A., Trans. Electrochemical Society, vol. 90 (1946), page 397.

Mr. RITCHIE. Purchase order from the United States Army Transportation Corps, San Francisco Port of Embarkation, dated March 1949, for $3,500 worth of Battery AD–X2. These people found Battery AD–X2 to be beneficial. These people were stopped from using the material by orders from higher authority.

(The document above referred to is as follows:)

DEPARTMENT OF THE ARMY PURCHASE ORDER

This contract is authorized under the provisions of Public Law 413, 80th Congress (Armed Services Procurement Act of 1947).

DATE: Mar.49 | CONTRACT NO. (If any):

SHEET NO. 1 | NO. OF SHEETS 2 | ORDER NO. SFPR 15501

ABOVE CHECKED NO. (S) MUST APPEAR ON ALL PICK A PAPERS REL TO THIS ORDER

ISSUED BY: Procurement Division, San Francisco Port of Embarkation, Fort Mason, California

REQUISITION NO.: | DIRECTIVE NO. P.R. 6247-49

TO: (Contractor and address; also factory address, if required)

Pioneers Incorporated
2411 Grove Street
Oakland, 12, California

PAYMENT WILL BE MADE BY FINANCE OFFICER, U.S. ARMY, Oakland Army Base, Oakland 14, California

INVOICE FOR PAYMENT WILL BE MAILED TO: Finance Officer, U.S. Army, Oakland Army Base, Oakland 14, California

SHIP TO: Property Offr. Port TC Supply Divn.
Whse. 5, Oakland Army Base
Oakland, 14, California
MARK: "SCAPS" 1243-49

THE SUPPLIES AND SERVICES TO BE OBTAINED BY THIS INSTRUMENT ARE AUTHORIZED BY, AND FOR THE PURPOSES SET FORTH IN, AND ARE CHARGEABLE TO THE FOLLOWING ALLOTMENTS. THE AVAILABLE BALANCES OF WHICH ARE SUFFICIENT TO COVER THE COST THEREOF:
2192409 909-1166 P481-08
(Advice no. 139-49) S36-022

IN ACCORDANCE WITH YOUR PRICE LIST/ORAL QUOTATION/WRITTEN QUOTATION OF _____ PLEASE FURNISH THE FOLLOWING ON THE TERMS SPECIFIED ON BOTH SIDES OF THIS PAGE AND* INCLUDING DELIVERY F.O.B. Destination

METHODS OF PRESENTING INVOICES OR VOUCHERS AND OF PACKING, MARKING, AND SHIPPING, SHALL BE AS PROVIDED HEREIN, EXCEPT AS OTHERWISE DIRECTED BY THE CONTRACTING OFFICER

DISCOUNT TERMS: Net 30 Days

SCHEDULE OF DELIVERIES: 3 March 1949.

INSPECTION POINTS: Destination

ITEM NO.	SUPPLIES OR SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
	Confirmation. DO NOT DUPLICATE.				
	Desulfator: ADX2 Battery (12 pkgs. per carton, 25 cartons per case.)	7	cases	500.00	3500.00
	Negotiated under the provisions of: ASPR 3-210.2(a)				
	For: Finance Officer. FORWARD COPY OF VOUCHER TO: FISCAL OFFICE, TRANSPORTATION CORPS DEPOT MARIETTA, PENNSYLVANIA - 36-022.				
	BURNSIDE:hmg 3 March 1949.				
				TOTAL	$3500.00

*Special Conditions 1 Attached hereto and made a part hereof.

UNITED STATES OF AMERICA
BY [signature]
C. E. HIGBEE
PURCHASING AND CONTRACTING OFFICER

WD FORM 18
REV 19 MAY 48

Mr. RITCHIE. Dr. Randall passed away on March 17, 1950. He advised me not to change anything and not to divulge anything on the formula or process.

As an exhibit, a purchase order from the United States Marine Corps, San Francisco Supply Depot, dated August 7, 1950, for $10,996.20 for battery AD–X2.

(The document above referred to is as follows:)

Subject to an appropriation by the Congress

UNITED STATES MARINE CORPS

dmm

Schedule No---------- Requisition No. DQSF (109–50) M.T. for Barstow
Opening date---------- Negotiated Contract No. N52m–25212

The articles of services to be furnished under the particular item number, the price, the time and place of delivery thereof, the specifications and preference rating and any other special provisions pertaining thereto are as follows:

Pioneers, Inc.,
2411 Grove Street,
Oakland 12, California.

Order No. 16423.
Dated: 7 August 1950.

Item No.	Quantity	Article	Price	Unit	Total
1	6,000 pkgs.	(treatment units) Battery AD–X2 antisulfation agent sufficient to treat approximately 1,000 9–T lead-acid storage batteries; having a volume content of 5.78 (per cell) quarts; each battery requiring 6 treatment pkg per battery of three cells, AD–X2 to be packed 3 envelopes per package. 12 packages per carton, 25 cartons per case.	$1.66⅔	ea	$10,000.00
2		For furnishing all necessary supervisory personnel for the application of above-mentioned treatments.	996.20	job	996.20
					10,996.20

Please substitute for copies previously furnished.

Discount.—Item 1—2% 20 Days; Item 2—Net.

Delivery.—F. o. b., Barstow Annex (Marine Corps Depot of Supplies), Barstow, California, consigned to the Commanding Officer (Motor Transport) thereat on or before 7 August 1950.

Complete application to be finished on or before August 21, 1950, and at such time batteries are to have been charged and checked.

Guarantee.—Contractor hereby warrants that all batteries charged are guaranteed for a period of one year and/or twelve (12) service units.

Payment.—Render invoice in SEXTUPLICATE to the Depot Quartermaster, U. S. Marine Corps Depot of Supplies, 100 Harrison Street, San Francisco, California.

Note.—Copy of "NOTICE," containing stipulations pertaining to the Walsh-Healey Public Contracts Act, is attached for posting by your company. This contract executed pursuant to ASPA–PL–413, Section 2 (c) 2.

1711106.11 MCT&F FY 1951—QMGMC Auth. 807, 089, 87119 A.

Mr. RITCHIE. A purchase order from the United States Marine Corps, San Francisco Port of Embarkation, dated September 27, 1950, for $2,994 for battery AD–X2.

(The document above referred to is as follows:)

CONTRACT

UNITED STATES MARINE CORPS

Negotiated Contract No. N52m–25483 ASPA–PL–413, Section 2 (c) 2.
Pioneers, Inc., Contractor.
Contract for antisulfation battery agent. Amount, $2,994.00.
Place: U. S. Marine Corps Depot of Supplies, 100 Harrison St., San Francisco, California.

This contract, entered into as of 27 September 1950, by and between the UNITED STATES OF AMERICA, hereinafter called the Government, represented by the contracting officer executing this contract and PIONEERS, INC., (i) a corporation organized and existing under the laws of the State of California, (ii) a partnership consisting of , (iii) an individual trading as , whose address is 2411 Grove Street, Oakland 12, California, hereinafter called the Contractor.

Witnesseth, that the parties hereto do mutually agree as follows:

GENERAL PROVISIONS

1. Definitions

As used throughout this contract, the following terms shall have the meanings set forth below:

(*a*) The term "Secretary" means the Secretary, the Under Secretary, or any Assistant Secretary of the Department and the head or any assistant head of the executive agency; and the term "his duly authorized representative" means any person or persons or board (other than the Contracting Officer) authorized to act for the Secretary.

(*b*) The term "Contracting Officer" means the person executing this contract on behalf of the Government, and any other officer or civilian employee who is a properly designated Contracting Officer; and the term includes, except as otherwise provided in this contract, the authorized representative of a Contracting Officer acting within the limits of his authority.

(*c*) Except as otherwise provided in this contract, the term "subcontracts" includes purchase orders under this contract.

2. Changes

The Contracting Officer may at any time, by a written order, and without notice to the sureties, make changes, within the general scope of this contract, in any one or more of the following: (i) Drawings, designs, or specifications, where the supplies to be furnished are to be specially manufactured for the Government in accordance therewith; (ii) method of shipment or packing; and (iii) place of delivery. If any such change causes an increase or decrease in the cost of, or the time required for, performance of this contract, an equitable adjustment shall be made in the contract price or delivery schedule, or both, and the contract shall be modified in writing accordingly. Any claim by the Contractor for adjustment under this clause must be asserted within 30 days from the date of receipt by the Contractor of the notification of change: *Provided, however,* That the Contracting Officer, if he decides that the facts justify such action, may receive and act upon any such claim asserted at any time prior to final payment under this contract. Failure to agree to any adjustment shall be a dispute concerning a question of fact within the meaning of the clause of this contract entitled "Disputes." However, nothing in this clause shall excuse the Contractor from proceeding with the contract as changed.

3. Extras

Except as otherwise provided in this contract, no payment for extras shall be made unless such extras and the price therefor have been authorized in writing by the Contracting Officer.

4. Variation in quantity

No variation in the quantity of any item called for by this contract will be accepted unless such variation has been caused by conditions of loading, shipping, or packing, or allowances in manufacturing processes, and then only to the extent, if any, specified elsewhere in this contract.

5. Inspection

(*a*) All supplies (which term throughout this clause includes without limitation raw materials, components, intermediate assemblies, and end products) shall be subject to inspection and test by the Government, to the extent practicable at all times and places, including the period of manufacture, and in any event prior to final acceptance.

(*b*) In case any supplies or lots of supplies are defective in material or workmanship or otherwise not in conformity with the requirements of this contract, the Government shall have the right either to reject them (with or without instructions as to their disposition) or to require their correction. Supplies or lots of supplies which have been rejected or required to be corrected shall be removed or corrected in place, as requested by the Contracting Officer, by and at

the expense of the Contractor, promptly after notice, and shall not again be tendered for acceptance unless the former tender and either the rejection or requirement of correction is disclosed. If the Contractor fails promptly to remove such supplies or lots of supplies, when requested by the Contracting Officer, and to proceed promptly with the replacement or correction thereof, the Government either (i) may by contract or otherwise replace or correct such supplies and charge to the Contractor the cost occasioned the Government thereby, or (ii) may terminate this cotnract for default as provided in the clause of this contract entitled "Default." Unless the Contractor elects to correct or replace the supplies which the Government has a right to reject and is able to make such correction or replacement within the required delivery schedule, the Contracting Officer may require the delivery of such supplies at a reduction in price which is equitable under the circumstances. Failure to agree to such reduction of price shall be a dispute concerning a question of fact within the meaning of the clause of this contract entitled "Disputes."

Mr. RITCHIE. Remarks: This material was sold at the beginning of the Korean police action and was used in batteries from 5 to 7 years old which were unattainable on the market at that time. By using Battery AD–X2, the Marine Corps reduced the charging time of these batteries from 7 days to 30 hours.

Insert: October 27, 1950, University of San Francisco report of continuation of test from December 13, 1949, on battery AD–X2, Incidentally, I checked on these batteries in the latter part of 1952, and they were still functioning satisfactorily at the time. This report is signed by Karl J. Waider, chairman, department of physics, University of San Francisco.

(The document above referred to is as follows:)

UNIVERSITY OF SAN FRANCISCO,
DEPARTMENT OF PHYSICS,
San Francisco 17, Calif., October 27, 1950.

Mr. JESS M. RITCHIE,
President, Pioneers, Inc.,
2411 Grove Street, Oakland 12, Calif.

DEAR MR. RITCHIE: The following is a report on the batteries about which we have already reported to you.

These batteries were last charged, before the test herein contained, in May 1950 just before the close of the spring semester. They have scarcely been used since that date.

Hydrometer readings and voltage tests were made on October 24, 1950, as follows:

Battery number	(P), cell 1	(C), cell 2	(N), cell 3	Battery number	(P), cell 1	(C), cell 2	(N), cell 3
	Volts	*Volts*	*Volts*		*Volts*	*Volts*	*Volts*
1	2	2	2	5	2	2	2
2	2	2	2	6	2	2	2
3	2	2	2	7	2	2	2
4	2	2	2				

HYDROMETER READINGS, ROOM TEMPERATURE 73° F.

Battery number	(P), cell 1	(C), cell 2	(N), cell 3	Battery number	(P), cell 1	(C), cell 2	(N), cell 3
1	1.250	1.200	1.225	5	1.200	1.200	1.275
2	1.225	1.200	1.225	6	1.275	1.175	1.250
3	1.225	[1] Dry	1.200	7	[1] Dry	1.175	1.225
4	1.250	1.175	1.200				

[1] Cell cracked, not sufficient electrolyte for reading.

These batteries were then charged for 34 hours at 6 amp. rate. The voltages remain unchanged in all cases. The hydrometer readings were as follows:

Battery No.	(P) cell 1	(C) cell 2	(N) cell 3	Battery No.	(P) cell 1	(C) cell 2	(N) cell 3
1	1.250	1.275	1.250	5	1.250	1.275	1.275
2	1.275	1.275	1.250	6	1.275	1.275	1.100
3	1.250	[1] Dry	1.200	7	[1] Dry	1.250	1.250
4	1.275	1.250	1.225				

[1] Dry. Cracked cells—not sufficient electrolyte for a reading.

I am not prepared to make any comments on these readings. The fact remains that the batteries are doing a satisfactory job for the purposes of our laboratory work.

Sincerely,

Signed: Karl J. Waider,
KARL J. WAIDER,
Chairman.

Mr. RITCHIE. Letter Circular 504 of the National Bureau of Standards, dated January 10, 1951, signed by P. L. Howard and George Wood Vinal, which was discussed yesterday. Briefly, to reiterate, the test tables indicate that the batteries in this test were ruined by prolonged overcharging prior to treatment. There is no indication that the batteries were opened for inspection to establish the conditions of the samples prior to the beginning of the test.

(The document above referred to appears in the appendix.)

Mr. RITCHIE. Insert transmittal letter and an affidavit by Dr. H. Zeh Hurlburt of Consolidated Chemical Industries, Inc., Houston, Tex., dated April 17, 1953, concerning a conversation he had with Paul L. Howard, of the Bureau of Standards in May 1951, on Circular 504 as to whether or not Battery AD–X2 was used in the test of this report.

(The documents above referred to are as follows:)

CONSOLIDATED CHEMICAL INDUSTRIES, INC.,
Houston, Tex., April 17, 1953.

Dr. JESS RITCHIE,
Claridge Hotel, Apartment 4A,
820 Connecticut Avenue NW., Washington, D. C.

DEAR MR. RITCHIE: Enclosed you will find copies of the Affidavit which you requested. I hope that they will be of help to you. You will note that I have quoted Mr. Howard directly in the affidavit. I remember his exact words at that time mainly because I was so shocked at his skepticism. Unfortunately I do not remember his exact words during the other parts of the conversation, but I have reported their substance accurately in the Affidavit.

If the man had been convinced, by a faulty analysis or through ignorance of the effect of trace elements, that Battery AD–X2 contained only sodium sulfate and magnesium sulfate then he would have been justified in refusing to test Battery AD–X2; however, I gained the impression that he was actively prejudiced against Battery AD–X2 and that he considered it to be a deliberately perpetrated hoax. These are the impressions that I gained in talking with Mr. Howard, needless to say I was shocked as well as personally insulted, since, by implication, my father was involved in a fraud. Even though I knew that Battery AD–X2 was not a fraud, it disturbed me that Mr. Howard should think so.

Please accept my sincere wishes for continued success in the attempt you are making.

Very truly yours,

H. ZEH HURLBURT,
3938 Tristan Ave., Houston, Tex.

AFFIDAVIT

APRIL 17, 1953.

To Whom It May Concern:

This is to certify that a conversation took place during the first week of May 1951 at the National Bureau of Standards in Washington, D. C., between P. L. Howard and the undersigned during which conversation Mr. Howard said that, according to analyses available to him, Battery AD–X2 was a mixture of sodium and magnesium sulfates and that they did not test Battery AD–X2 because they had already tested mixtures of sodium sulfate and magnesium sulfate.

Regarding the article concerning Battery AD–X2 which appeared in Newsweek and an article on Battery AD–X2 in the trade journal "The Battery Man," Mr. Howard said, "Of course you know that these are paid articles.", and would not accept my assurances that they were not paid articles.

I swear that the above statements are true to the best of my knowledge and recollection.

H. ZEH HURLBURT

Before me the undersigned authority on this 17th day of April, 1953, personally appeared H. Zeh Hurlburt who upon oath deposed and stated that the foregoing statements are true and correct.

A. L. CRAIG,
Notary Public, in and for Harris County, Tex.

My commission expires June 1954.

Mr. RITCHIE. Insert: Letter dated June 5, 1951, from the Chief of the Electrochemistry Section of the Bureau of Standards, to Jess M. Ritchie in reply to request for information on test and analysis of Battery AD–X2 on May 29, 1951. Quoting from the Bureau of Standards' letter:

The technical results of the test are administratively restricted information.

(The document above referred to is as follows:)

UNITED STATES DEPARTMENT OF COMMERCE,
NATIONAL BUREAU OF STANDARDS,
Washington 25, D. C., June 5, 1951.

Mr. JESS M. RITCHIE,
President, Pioneers, Inc.,
Oakland, 12, Calif.

DEAR MR. RITCHIE: In reply to your letter of May 29, the National Bureau of Standards, as a portion of its assigned services is required to provide test services to other Federal agencies for use in their purchase, or in the operation and enforcement of their assigned legal responsibilities. The nature of the agency requesting tests, the source of funds they use and the technical results of the test are administratively restricted information in that this Bureau cannot release such information without approval of the agency for which the service is rendered. You will note that in Circular 504 we did not publish brand names of manufacturers. Without approval from the supporting agencies we are not in position to supply the specific information you requested on "Battery AD–X2."

In the informal discussion of battery additives with our Mr. Howard, Dr. Hurlburt mentioned both the articles in Newsweek and Battery Man as if they were articles sponsored by Pioneers, Inc. Mr. Howard denies stating that they were paid articles. However, he did ask if they were. Dr. Hurlburt replied in the negative and no further consideration was given to the matter. It was not unnatural for Mr. Howard to inquire if the articles were paid articles in view of their contents.

Very truly yours,

WALTER J. HAMER,
Chief, Electrochemistry Section, Electricity Division.

Copy to:
Senator Wm. F. Knowland.
National Better Business Bureau.
Oakland Better Business Bureau.
San Francisco Better Business Bureau.

Mr. RITCHIE. A letter dated July 9, 1951, from the Chief of the Electrochemistry Section of the Bureau of Standards, to Jess M.

Ritchie, stating that statements in Battery Compounds and Solutions published by the National Better Business Bureau condemning battery AD–X2 by name had been approved by the administrative officers of the Bureau of Standards.

(The document above referred to is as follows:)

UNITED STATES DEPARTMENT OF COMMERCE,
NATIONAL BUREAU OF STANDARDS,
Washington 25, D. C., July 9, 1951.

Mr. JESS M. RITCHIE,
President, Pioneers, Inc., Oakland 12, Calif.

DEAR MR. RITCHIE: I have your letter of June 29. I find that I have a complete file on Battery AD–X2 dating from April 23, 1948, through 1949. In my letter of June 5, my remarks referred to the questions of funds and the agencies for which we may make tests, and not to tests on battery additives. I felt that you were aware of our tests in view of the Bulletin of the National Better Business Bureau and was somewhat puzzled by your question, "In view of this, we ask this question: Has the National Bureau of Standards ever tested Battery AD–X2 manufactured by Pioneers, Inc., 2411 Grove Street, Oakland 12, Calif.?"

I find that the statements appearing in the issue of August 1950 of the National Better Business Bureau had the approval of our administrative officials. Your correspondence to us and to them requesting that an exception be made publicly to "Battery AD–X2" on the grounds that the National Bureau of Standards had not tested this material had a bearing on this decision.

Very truly yours,

WALTER J. HAMER,
Chief, Electrochemistry Section, Electricity Division.

Copy to Mr. Edward L. Greene, NBBB.

Mr. RITCHIE. Letter dated July 31, 1951, to Senator Ed C. Johnson and Senator Eugene D. Millikin, from Acting Director of the Bureau of Standards—Dr. A. V. Astin—stating that battery AD–X2 was the same as additives known to be worthless.

(The document above referred to is as follows:)

U. S. DEPARTMENT OF COMMERCE,
NATIONAL BUREAU OF STANDARDS,
Washington 25, July 31, 1951.

Hon. ED C. JOHNSON,
Hon. EUGENE D. MILLIKIN,
United States Senate, Washington, D. C.

MY DEAR SENATORS: Careful consideration has been given to your letter of July 27 and to the letter of July 21 from H. W. Christoffers, of Denver, Colorado, referring to a battery material known as "Battery AD–X2," manufactured by Pioneers, Inc., 2411 Grove Street, Oakland 12, California. We may state at once that the National Bureau of Standards has tested "Battery AD–X2."

Pioneers, Inc., recently have stressed the claim that they have effected a great saving in the consumption of lead, a critical material, by rebuilding old, worn-out batteries and using "Battery AD–X2" in this rebuilding process. It is an established fact that old, "dead" batteries can be made serviceable and almost as good as new by rebuilding them without the use of any battery additive. When a consumer wishes to obtain a new battery he generally turns in his old one. The manufacturers reclaim over 90 percent of the lead of an old battery and use it in the construction of a new one. The waste or loss of lead in the storage-industry is, therefore, at a minimum. "Battery AD–X2" does not in any case effect a saving in lead consumption.

During the past 25 years several hundred materials alleged to improve the performance of storage batteries or rejuvenate "dead" batteries have appeared. From time to time the Bureau has tested typical additives either for its own information or at the request of other government agencies. Our findings were first reported in our Letter Circular No. 302 of May 15, 1931, and later in our Circular 504 of January 10, 1951. We did not find "Battery AD–X2" to be beneficial to storage batteries. This material consists of partially dehydrated Epsom Salts and sodium sulfate. This mixture does not differ substantially from many other additives that have been distributed to the public and known to be worthless.

I am enclosing a copy of Circular 504 for your information. You will note that no brand names are designated: the Bureau neither approves nor disapproves proprietary products. Its function in matters of this kind is factfinding with respect to materials. We are informing you that AD–X2 was included in our studies because the charge has been repeatedly made that it was not. Even had it not been tested, however, the statements made in Circular 504 are true, for they refer to basic materials.

As to the test method: the procedures followed by the Bureau in this study yield conclusive results. The method itself is accepted as valid by the automotive industry: it is the standard test devised by the Society of Automotive Engineers.

The Armed Forces have also made independent tests of this material. "Battery AD–X2" was tested by the Signal Corps Laboratory at Fort Monmouth, New Jersey, and by the New York and Mare Island Navy Yards, and was found to be of no benefit to storage batteries.

Let me assure you that the Bureau's attitude on matters of this kind is objective and fair. We are keenly interested in any development which would either improve performance and life of a commodity like batteries or which would save critical materials. We also hope that our findings will protect distributors from investing in products that have no merit.

The file which you enclosed with your letter is returned herewith.

Sincerely yours,

A. V. ASTIN, *Acting Director.*
E. U. CONDON, *Director.*

Mr. RITCHIE. Insert: Letter dated August 1, 1951, to Senator Lyndon Johnson, from Acting Director of the Bureau of Standards, Dr. A. V. Astin. Quoting:

This material consists of a partially dehydrated epsom salts and sodium sulfate. This mixture does not differ substantially from the many other additives that have been distributed to the public and known to be worthless.

Further quoting:

We also hope that our findings will protect distributors from investing in products that have no merit.

(The document above referred to is as follows:)

U. S. DEPARTMENT OF COMMERCE,
NATIONAL BUREAU OF STANDARDS,
Washington 25, D. C., August 1, 1951.

Hon. LYNDON S. JOHNSON,
United States Senate,
Washington, D. C.

MY DEAR SENATOR: Careful consideration has been given to your memorandum of July 27 and to the letter of July 23 from H. S. Hurlburt, of Houston, Texas, referring to a battery material known as "Battery AD–X2" manufactured by Pioneers, Inc., 2411 Grove Street, Oakland 12, California. We may state at once that the National Bureau of Standards has tested "Battery AD–X2."

Pioneers, Inc., recently have stressed the claim that they have effected a great saving in the consumption of lead, a critical material, by rebuilding old worn out batteries and using "Battery AD–X2" in this rebuilding process. It is an established fact that old "dead" batteries can be made serviceable and almost as good as new by rebuilding them without the use of any battery additive. When a consumer wishes to obtain a new battery he generally turns in his old one. The manufacturers reclaim over 90 percent of the lead of an old battery and use it in the construction of a new one. The waste or loss of lead in the storage battery industry is, therefore, at a minimum. "Battery AD–X2" does not in any case effect a saving in lead consumption.

During the past 25 years several hundred materials alleged to improve the performance of storage batteries or rejuvenate "dead" batteries have appeared. From time to time the Bureau has tested typical additives either for its own information or at the request of other government agencies. Our findings were first reported in our Letter Circular No. 302 of May 15, 1931, and later in our Circular 504 of January 10, 1951. We did not find "Battery AD–X2" to be beneficial to storage batteries. This material consists of partially dehydrated Epsom Salts and sodium sulfate. This mixture does not differ substantially

from many other additives that have been distributed to the public and known to be worthless.

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As to the test method: the procedures followed by the Bureau in this study yield conclusive results. The method itself is accepted as valid by the automotive industry; it is the standard test devised by the Society of Automotive Engineers.

The Armed Forces have also made independent tests of this material. "Battery AD–X2" was tested by the Signal Corps Laboratory at Fort Monmouth, New Jersey, and by the New York and Mare Island Navy Yards, and was found to be of no benefit to storage batteries.

Let me assure you that the Bureau's attitude on matters of this kind is objective and fair. We are keenly interested in any development which would either improve performance and life of a commodity like batteries or which would save critical materials. We also hope that our findings will protect distributors from investing in products that have no merit.

The file which you enclosed with your letter is returned herewith.

Sincerely yours,

A. V. ASTIN, *Acting Director.*
E. U. CONDON, *Director.*

Mr. RITCHIE. Insert letter from Chief, Electrochemistry Section of Bureau of Standards, dated August 22, 1951, to Pioneers, Inc. Quoting:

If you desire additional information, I suggest that you contact the Federal Trade Commission, Washington 25, D. C.

(The document above referred to is as follows:)

DEPARTMENT OF COMMERCE,
NATIONAL BUREAU OF STANDARDS,
Washington, August 22, 1951.

Mr. JESS M. RITCHIE,
President, Pioneers, Incorporated,
2411 Grove Street, Oakland 12, California.

DEAR MR. RITCHIE: In reply to your letter of August 17, for our information we have analyzed "Battery AD–X2" both qualitatively and quantitatively. Our conclusions, however, were based on performance tests rather than on chemical constitution.

If you desire additional information, I suggest that you contact the Federal Trade Commission, Washington 25, D. C.

Very truly yours,

WALTER J. HAMER,
Chief, Electrochemistry Section,
Electricity Division.

Mr. RITCHIE. Insert letter dated August 8, 1951, from Secretary of Commerce Charles Sawyer to Senator Tom Connally, stating that he has asked the Director of the Bureau of Standards to look into the battery AD–X2 problem personally.

(The document above referred to is as follows:)

DEPARTMENT OF COMMERCE,
Washington, August 8, 1951.

The Honorable TOM CONNALLY,
United States Senate, Washington, D. C.

MY DEAR SENATOR: This will acknowledge your letter of August 1, which was not received until August 6.

I am sending it on to Dr. Condon and asking him personally to appraise the situation as outlined by Mr. Wallace and to write you fully about the matter

when he has done so. You may be sure it will be carefully and thoroughly studied in the Bureau of Standards before a decision is reached.

Sincerely yours,

CHARLES SAWYER,
Secretary of Commerce.

Mr. RITCHIE. Insert letter dated August 31, 1951, to the Honorable Herbert H. Lehman, New York, from Acting Director of the Bureau of Standards, Dr. A. V. Astin. Quoting:

For your information a copy of this memorandum is enclosed.

This is the Letter Circular 504. Its contents apply to battery AD–X2.

(The document above referred to is as follows:)

DEPARTMENT OF COMMERCE,
NATIONAL BUREAU OF STANDARDS,
Washington, August 31, 1951.

Hon. HERBERT H. LEHMAN,
United States Senate, Washington, D. C.

MY DEAR SENATOR: Careful consideration has been given to your memorandum of August 25 and to the letter of August 22, from Irving Dollinger of New York, referring to "Battery AD–X2." This is an old story dating back to early in 1948. During the past month 20 other Senators and one Congressman have been contacted by the distributors of "Battery AD–X2." Their letters are all similar in tone; a consistent pattern is evident in their approach. So far their letters fall into three groups: (1) the first stated that the National Bureau of Standards refused to test their material; (2) the second stated that their material was not field tested at this Bureau and stated or inferred that laboratory tests are insignificant; and (3) the third stated that laboratory tests after all are significant but that laboratory tests of this Bureau are not. Most distributors or expounders of battery additives claim that their materials are not properly tested. They have made this claim for the past 25 years. However, their recommended methods of test change as each previous one is refuted. Our methods of test are listed as items 1 to 9 on page 7 of Circular 504, a copy of which is enclosed.

In view of the voluminous correspondence on "Battery AD–X2," we have prepared a memorandum on battery additives which gives the position and policy of this Bureau on the testing of additives and gives some pertinent facts on the use of additives in storage batteries. For your information, a copy of this memorandum is enclosed. Its contents apply to "Battery AD–X2" although neither this material nor other additives are mentioned by name.

Let me assure you that the Bureau's attitude on matters of this kind is objective and fair. We are keenly interested in any development which would improve performance and life of a commodity like batteries.

The letter of Mr. Dollinger and the file which you enclosed are returned herewith.

Sincerely yours,

(Typed) E. U. CONDON,
Director.
(Signed) A. V. ASTIN,
Acting Director.

Mr. RITCHIE. Quoting from a letter dated October 17, 1951, to Senator Herbert H. Lehman, from Acting Director of the Bureau of Standards, Dr. A. V. Astin:

Because it would be contrary to the long-established policy of the Bureau of Standards, which is to give neither public condemnation nor endorsement to any specific brand-name product.

(The document referred to is as follows:)

U. S. DEPARTMENT OF COMMERCE,
NATIONAL BUREAU OF STANDARDS,
Washington 25, October 17, 1951.

Hon. HERBERT H. LEHMAN,
United States Senate, Washington, D. C.

MY DEAR SENATOR: This is in reply to your memorandum of October 8 and to the letter of October 5 from Irving Dollinger, of Battery AD–X2 Distributing Corporation of New York City, with reference to "Battery AD–X2," manufactured by Pioneers, Inc., 2411 Grove Street, Oakland 12, California. A letter commenting on an earlier communication from Mr. Dollinger was sent to you by the National Bureau of Standards on August 31. The inclosures sent with Mr. Dollinger's more recent letter contain no pertinent additional information other than what was available to, and considered by, this Bureau in our letter of August 31.

It would appear that those interested in promoting Battery AD–X2 cannot be satisfied unless the National Bureau of Standards specifically exempts Battery AD–X2 from the conclusions of NBS Circular No. 504 on Battery Additives. This cannot be done (1) because it would be contrary to the conclusive results of the carefully planned and conducted experiments reported in the circular and (2) because it would be contrary to the long-established policy of the National Bureau of Standards, which is to give neither public condemnation nor endorsement to any specific brand-named product.

The letter from Mr. Dollinger and the file which you enclosed are returned herewith.

Sincerely yours,

(Signed) A. V. Astin,
A. V. ASTIN, *Acting Director.*

Mr. RITCHIE. Insert letter from Commercial Car Journal, dated October 19, 1951, notifying Pioneers, Inc., that they can no longer accept Pioneers' advertising. This was done at the instigation of a representative of the Exide Battery Co. Also, I would like to insert here an advertisement of Pioneers, Inc., which appeared in the Idaho Daily Statesman, on April 2, 1951.

(The documents referred to are as follows:)

COMMERCIAL CAR JOURNAL,
Philadelphia 39, Pa., October 19, 1951.

Re Pioneers, Inc.

Mr. GEORGE C. MCNUTT,
Geo. C. McNutt, Advertising, 3031 Telegraph Avenue, Oakland 12, Calif.

DEAR MR. MCNUTT: This letter was bad enough to write the first time, when, fortunately, I didn't have to mail it to you, because we received a cancellation of advertising for Pioneers, Inc., in Commercial Car Journal.

I deposited my letter in the wastebasket with a sigh of relief, and now I have to start all over.

The reason is that we now have an order from you for a half-page advertisement for Pioneers, Inc., in the November issue of Commercial Car Journal and, although we have no reinstatement of the contract which I have ordered to be short-rated, I presume that you intended it to run.

Here is why we must omit it from November and thereafter until such time as the present problem is resolved.

Some weeks ago—at the time when your cancellation came in—I was summoned to the office of the President of Chilton Company, who had at his desk a representative of the advertising agency handling the Exide Battery account.

This gentleman was protesting the acceptance of Pioneers, Inc. advertising in Commercial Car Journal on the basis of the fact that the product has not been approved by the United States Bureau of Standards.

On occasions of this sort publishers are definitely placed in the middle, and it is fortunate that these things occur only at quite rare intervals.

The usual procedure—and the one which we must follow in this case—is to hold everything in abeyance until the accused manufacturer has an opportunity to make a statement in his own behalf.

In this case the statement would have to be that the product has been approved by the United States Bureau of Standards, because in its department it is the Supreme Court.

In the case of a publication like Commercial Car Journal, whose standing and integrity are high in the industry it serves, it is true that many readers assume that the acceptance of advertising by the publication is, at the same time, virtually approval of the product. When objections are formally presented therefore it is necessary to present the case to the advertiser involved—through his advertising agency when he has one—and, of course, to ask for the presentation of his side of the case.

That is the purpose of this letter. I am very sorry to be obliged to write it. I am sure that you will understand the necessity for it, and we hope that the situation may be clarified.

Cordially,

COMMERCIAL CAR JOURNAL,
EDWARD H. MILLER.
E. H. MILLER, *Advertising Manager.*

(Note by Pioneers, Inc.)

Pioneers, Inc., manufacture one product only, Battery AD–X2. Therefore, the foregoing affects the entire business of Pioneers, Inc.

[From the Idaho Daily Statesman, Boise, Idaho, April 2, 1951]

"THINK"

To the battery users of the great State of Idaho:

It has come to our attention that during the past couple of weeks a Boise distributor of a nationally known battery has handed out a large number of copies of a pamphlet "Periodical Bulletin No. 1458" (Revised), dated August 23, 1950, and prepared for members of the National Better Business Bureau, Inc., Chrysler Building, New York 17, N. Y.

Possibly you have received or will receive a copy of this bulletin.

We have no inclination to identify the person handing out these bulletins and we assume that he refrains from mailing them in order to maintain at least a partially anonymous position.

We do, however, wish to analyze the possible motives which he may have in taking this action.

The bulletin constitutes an impartial report by the National Better Business Bureau of correspondence on the subject of battery additives between Pioneer, Inc., and the National Bureau of Standards. According to the National Better Business Bureau the intent of the report is neither to endorse nor to condemn the particular additive "Battery AD–X2" as manufactured by Pioneers, Inc., of Oakland, Calif.

The person distributing these bulletins in Boise presumably is doing so for the purpose of causing the people of Boise to refrain from using Battery AD–X2.

Why is he interested in that result?

If he believes that Battery AD–X2 will harm a battery then for his own purposes he should be interested in stimulating instead of reducing the use of Battery AD–X2 because if its use is harmful to batteries his business should prosper through the sale of replacement for the batteries which have been injured by Battery AD–X2. Also, since the battery manufacturers and distributors void their warranties when an additive is used in a battery, the possibility that a battery might be injured by the addition of Battery AD–X2 cannot possibly involve an increase in warranty liability of the person distributing these bulletins or of the manufacturer whose batteries are marketed by him.

If his purpose is to convince you that Battery AD–X2 has no effect on a battery, either beneficial or harmful, then he should not be concerned at all for, on the one hand his business will not be hurt by the prolongation of battery life expectancy through the use of Battery AD–X2. On the other hand his warranty liability or the warranty liability of the manufacturer of the batteries distributed by him may actually be reduced in that it will be eliminated with respect to batteries which without the addition of Battery AD–X2 would not have performed satisfactorily for the warranty period.

Logically, then, his reason for the distribution of these bulletins must be that he recognizes that the use of Battery AD–X2 will in fact prolong the life expectancy of your batteries and thus will reduce his opportunity to replace them with as great frequency as he otherwise might anticipate.

What is offered to you through the use of Battery AD–X2 and the Battery AD–X2 Service System?

The individual in your community who offers this product to you has been a respected citizen of that community for many years. He has his office at 624 North 10th Street and a battery reprocessing plant at Goven Field in Boise. If you use the Battery AD–X2 Service System and have your batteries treated with Battery AD–X2 he will either offer to extend the battery manufacturer's warranty on your mechanically sound treated batteries by six service units, which, in passenger car service, is 6 months or 6,000 miles, whichever first occurs, or he will refund to you the money you paid for Battery AD–X2 if you are not satisfied with its performance which is in accordance with the policy established by Pioneers, Inc. In this connection, we carry product insurance.

What is the experience of other users of Battery AD–X2?

We quote from the statements of a few satisfied users as follows:

Dinwiddie Construction Co., 22d and Magnolia Streets, Oakland, Calif., has used Battery AD–X2 since October 1947. They report: "For the new and serviceable batteries treated (with Battery AD–X2), the direct result has been a 70 percent decrease in replacements."

Permanente Cement Co., Permanente, Calif., has used Battery AD–X2 since February 1948 and state: "Previous to the time of Battery AD–X2 treatment our yearly battery costs for rebuilts and replacements amounted to $1,830.77. After treatment (with Battery AD–X2) our 1948 costs were $936.26, a surprising substantial savings of $894.51 in actual battery purchases."

The electrical department of the city of Oakland, Calif., users of Battery AD–X2 since December 1947, through Mr. R. B. Lohry, engineer in charge of the radio division, states: "If a new battery is treated with Battery AD–X2 and given an equalizing charge prior to installation, it is estimated conservatively that the life expectancy will be extended two and one-half times the normal life prior before failure."

You must bear in mind that the foregoing statements and other statements of a like nature which we have received from satisfied users are not claims made by Pioneers, Inc., but are statements from users of the product who have bought and paid for Battery AD–X2 and have used it over a long period of time.

A further service offered to you under the Battery AD–X2 service system is that you can purchase from a respected citizen in your community a reprocessed battery carrying a nonprorated full money back 12-month guarantee at approximately one-half of the market price of a new battery.

Finally, we should comment on the fact that it is the policy of certain battery manufacturers to recommend to their dealers that when junk batteries are returned to them a hole be punched through the cell partitions of the batteries so that they may not be salvaged. Keeping in mind that "junk" batteries which have been reprocessed under the Battery AD–X2 service system have been marketed by the thousands for a number of years on the west coast with a nonprorated guarantee, it is our suggestion and recommendation that you take your "junk" batteries to your local Battery AD–X2 representative and have him reprocess them and return them to you with a 12-month full money back nonprorated guarantee.

In summary then, we submit to you as reasonable persons that the only logical purpose behind the distribution of the National Better Business Bureau bulletin is to cause you to refrain from using Battery AD–X2 or taking advantage of the Battery AD–X2 service system, and that the motive behind the distribution of the bulletin is to eliminate his competition because of his realization that Battery AD–X2, in extending the life expectancy of batteries, could cut the potential of his battery sales by more than 50 percent.

Unlike the person distributing these bulletins we wish to identify ourselves completely. We are Pioneers, Inc., 2411 Grove Street, Oakland 12, Calif., and we manufacture Battery AD–X2 and distribute and sell it throughout the United States and foreign countries.

JESS M. RITCHIE,
President of Pioneers, Inc.

Battery AD–X2, M. Ned Williams, Distributor, Phone 4461—9486.

Mr. RITCHIE. A letter dated November 2, 1951, to Senator Henry C. Dworshak, from James Mead, Chairman of the Federal Trade Commission, stating that they are attempting to get tests run in accordance with the manufacturer's directions for use of the product Battery AD–X2; that as a Government agency they must rely on the Bureau of Standards for technical advice.

(The document above referred to is as follows:)

FEDERAL TRADE COMMISSION,
Washington 25, D. C., November 2, 1951.

Re Pioneers, Inc., File No. 1–23115.

Hon. HENRY C. DWORSHAK,
United States Senate, Washington, D. C.

MY DEAR SENATOR: This is in further answer to your letter dated October 24, 1951, to the Commission's Bureau of Industry Cooperation relative to a matter involving advertising claims referring to the product "Battery AD–X2" disseminated by Pioneers, Inc. Your suggestion that a test independent of the National Bureau of Standards be made has been particularly noted.

The Commission has reviewed this matter very carefully and has decided to have new and additional tests made with respect to the product by the National Bureau of Standards. It is being requested that the Bureau make such tests expeditiously, and that the tests conform, insofar as is possible, to the manufacturer's directions for use of the product. Upon receipt of a report on such tests, the Commission will further consider the matter and will advise you accordingly.

You undoubtedly appreciate the fact that the Commission must, as a United States Government agency, rely where possible upon other Government agencies for technical advice and assistance. The Bureau of Standards, of course, has no biased interest in the tests which it runs, and the Commission has always found the Bureau most fair in its position on other matters in the past.

Please be assured that the Commission is anxious to arrive at a fair evaluation of the claims made by Pioneers, Inc., for their product, and that the Commission will give this matter careful final consideration at the earliest opportunity following receipt of results on the aforementioned additional tests.

Sincerely,

JAS. M. MEAD, *Chairman.*

Mr. RITCHIE. Letter to Senator Henry Cabot Lodge, Jr., dated December 4, 1951, from Dr. A. V. Astin, Acting Director of the Bureau of Standards. Quoting:

We would like to stress again that it is the established policy of the National Bureau of Standards to neither approve nor condemn any specific proprietary product.

(The document above referred to is as follows:)

UNITED STATES DEPARTMENT OF COMMERCE,
NATIONAL BUREAU OF STANDARDS,
Washington 25, D. C., December 4, 1951.

Hon. HENRY CABOT LODGE, Jr.,
United States Senate, Washington, D. C.

DEAR SENATOR LODGE: This is in reply to your memorandum of November 27, 1951, and to the letter of November 20, 1951, from Norman Goodwin of Guaranteed Batteries, Inc., Watertown 72, Mass., with reference to Battery AD–X2 and to the mimeographed letter of Edward H. Miller, advertising manager of Commercial Car Journal, Philadelphia 39, Pa. You have in your file previous letters and reports from us which cover the results of tests made by the National Bureau of Standards on battery additives and describe the policy of the Bureau with respect to testing specific brand-name products.

We would like to stress again that it is the established policy of the National Bureau of Standards neither to approve nor to condemn any specific proprietary product. Brand-name products are not referred to in publications of the Bureau; materials are identified only by their chemical composition. In view of the fact that Mr. Miller's letter gives the impression that the Bureau approves proprietary products we are addressing a letter to the Commercial Car Journal stating our policy.

Attached to Mr. Goodwin's letter was an excerpt from the Idaho Daily Statesman of April 2, 1951. This newspaper excerpt contains examples of the types of testimonial letters from allegedly satisfied users of Battery AD–X2 on which the claims of the manufacturer are primarily based. In no instance has the manufacturer supplied or made available quantitative test results which could be used as valid technical verification of his claims.

Mr. Goodwin's letter and enclosures contained therein are returned to you herewith.

Sincerely yours,

A. V. ASTIN, *Acting Director.*

Mr. RITCHIE. Remarks: The Bureau had been condemning Battery AD–X2, as previously pointed out, through the National Better Business Bureau by name since August 1950, as I said, in their publication, Battery Compounds and Solutions.

Letter from Jess M. Ritchie to Dr. Astin, of the Bureau of Standards, dated December 13, 1951, in which it is stated that the Bureau of Standards' three publications condemning all battery additives put out during 1951, together with National Better Business Bureau's pamphlet, titled "Battery Compounds and Solutions," condemning Battery AD–X2 by name, was ruining our business, and that since Dr. Astin was the new Director of the Bureau, he might possibly like to correct this situation.

(The letter above referred to is as follows:)

DECEMBER 13, 1951.

Dr. A. V. ASTIN,
U. S. Department of Commerce,
National Bureau of Standards,
Washington 25, D. C.

DEAR DR. ASTIN: In accordance with our telephone conversation this afternoon, we are enclosing a test on Battery AD–X2 by the University of San Francisco, covering somewhat better than a one-year period.

We also enclose a set of affidavits which were sent to your predecessor, Dr. E. U. Condon, some time ago. These people have not changed their minds and these same statements about the results they obtained from the use of Battery AD–X2 still stands.

In your letter of December 4, 1951, to the Hon. Henry Cabot Lodge, Jr., we quote, "We would like to stress again that it is the established policy of the National Bureau of Standards neither to approve nor to condemn any specific proprietary product. Brand-name products are not referred to in publications of the Bureau; materials are identified only by their chemical composition."

This same statement appears some twenty times in letters to Senators and in the same letters the statement is contradicted by stating that Battery AD–X2 has no merit.

We also enclose a pamphlet from the National Better Business Bureau which you stated in your telephone conversation of this date, you have not seen. This pamphlet has been distributed by the thousands by the National Better Business Bureau and portions of it have been reproduced by various battery distributors quoting your Bureau. This pamphlet condemns Battery AD–X2 both by naming the product "Battery AD–X2" and the manufacturer, Pioneers, Inc.

In our telephone conversation, I pointed out to you that there had been three releases this year which conclusively and irrevocably without exception, condemned all battery additives. These publicaions are: National Bureau of Standards #504, Letter Circular #1537 and National Bureau of Standards memorandum on Battery Additives, Washington, D. C., August 28, 1951. You said, in our telephone conversation, that these pamphlets were not necessarily intended to condemn Battery AD–X2. Yet, in your letter of August 31, 1951, to the Hon. Herbert H. Lehman, United States Senator, we quote: "In view of the voluminous correspondence on Battery AD–X2 we have prepared a memorandum on battery additives which gives the position and policy of this Bureau on the testing of additives and gives some pertinent facts on the use of additives in storage batteries. For your information, a copy of this memorandum is

enclosed. Its contents apply to Battery AD–X2 although neither this material nor other additives are mentioned by name."

Dr. Astin, these conflicting epistles and statements from your Bureau are working a tremendous hardship on Pioneers, Inc., and our distributors and is depriving the public of the use of a product which does everything that we, the manufacturers, claim for it. This is unjust, whether or not it is intentional. Therefore, we respectfully request that you immediately take the proper steps to clarify this situation.

An early reply to this letter would be appreciated.

Respectfully yours,

PIONEERS, INC.,
JESS M. RITCHIE, *President.*

JMR:V
cc: Senator Nixon.
Senator Knowland.
Senator Lehman.
Senator Lodge.
Senator Malone.
Senator Dworshak.
encls: Set affidavits.
U. of San Francisco tests (2).
Battery Man #2.
N. BBB Pamphlet dated August 1950.

Mr. RITCHIE. Insert: December 18, 1951, a letter from George Burger, vice president of the National Federation of Independent Businessmen, to the Director of the Bureau of Standards, pointing out that his organization had investigated Pioneers, Inc., and that he felt that something should be done concerning Letter Circular 504.

(The document above referred to is as follows:)

NATIONAL FEDERATION OF INDEPENDENT BUSINESSMEN,
Washington, D. C., December 18, 1951.

Dr. E. U. CONDON,
Acting Director, U. S. Department of Commerce,
National Bureau of Standards, Washington 25, D. C.

DEAR DR. CONDON: A Federation member, Pioneers, Inc., has brought to our attention the difficulty he is facing in his business due to the opinions expressed by the Bureau of Standards as to the worth of the product being manufactured by this concern, which he claims is to prolong the life of a battery.

It is my understanding that this concern has been in business for over five years, and it would appear to me from a letter you directed under date of August 7, 1951, to the Hon. John O. Pastore, and the letter you directed to Hon. Henry Cabot Lodge, Jr., under date of September 12, 1951, the third paragraph of the Pastore letter and the fourth paragraph of the Lodge letter differ in some degree. The two paragraphs referred to are quoted below:

"I am enclosing a copy of Circular 504 for your information. You will note that no brand names are designated; the Bureau neither approves nor disapproves proprietary products. Its function in matters of this kind is fact-finding with respect to materials. We are informing you that AD–X2 was included in our studies because the charge has been repeatedly made that it was not. Even had it not been tested, however, the statements made in Circular 504 are true, for they refer to basic materials.

"In view of the voluminous correspondence on 'Battery AD–X2', we have prepared a memorandum on battery additives which gives the position and policy of this Bureau on the testing of additives and gives some pertinent facts on the use of additives in storage batteries. For your information, a copy of this memorandum is enclosed. Its contents apply to 'Battery AD–X2' although neither this material nor other additives are mentioned by name."

It is interesting to note a copy of a letter the Federation member received through his advertising agent from the Commercial Car Journal. In a review of this letter, copy attached, you will note that the opposition to the advertisement in the Commercial Car Journal emanated from the Exide Representative. As you well know, they are large manufacturers of batteries for automobile use. Then again in this letter from the Commercial Car Journal note how the views of the Bureau of Standards are used, where in substance it

states "In this case the statement would have to be that the product has been approved by the United States Bureau of Standards, because in its department it is the Supreme Court."

Possibly I am wrongly informed, but I thought to a degree that the Bureau of Standards was authorized to protect Government purchases, in other words to make tests to see that the qualities the Government was securing were what Government specifications called for.

You may or may not recall in or around 1942 suggested standards were being considered for tire rebuilding. One prominent system, a very very successful system throughout the entire world, was not in a receptive mood to enter into adopting standards approved by the Bureau of Standards.

I recall shortly before World War II at a time when I was Secretary-General Manager of the National Tire Dealers Association, that I considered the advisability for the rubber industry to have standards approved by the Bureau of Standards as a protection to the public and a protection to the industry itself. I got nowhere in my approach with the rubber industry.

It is self-apparent that there has been no ruling on the product in question made by the Federation member that I can see, where it should be permitted to be used in a way which could injure his business, and apparently this is taking place.

I need not tell you that the influence of big companies in the automotive industry, due to their advertising program, are of tremendous importance. This view doesn't hold on with automotive publications, but we here had the same experience when we attempted to defend the action of the Government in a very important antitrust suit when our advertisement, full page ad, was rejected by three Washington papers, and the real truth in the rejections in at least two instances was that they were not going to take our advertisement and injure their business relationship with a very very large grocery chain. In fact the paper where the ad did appear was honest enough to say "If we were getting the ———— grocery company's ads we wouldn't have taken Burger's ad" (which meant the National Federation of Independent Business).

I trust, therefore, that this matter will be carefully reviewed and that I may hear from you at your conveniece.

Sincerely yours,

GEORGE J. BURGER, V. P.

CJB:ibh

Mr. RITCHIE. Insert: A letter dated January 21, 1952, from Acting Director of the Bureau of Standards, to Jess M. Ritchie, Pioneers, Inc., in reply to their letter of December 13, 1951. Quoting:

We would like to stress again that it is the established policy of the National Bureau of Standards neither to approve nor condemn any specific proprietary product.

Our files show that the bulletin of August 1950 of the National Better Business Bureau on Battery Compounds and Solutions was approved by the Director of the National Bureau of Standards prior to its release.

Again quoting from the same Bureau of Standards' letter:

Your letter claims that the National Bureau of Standards made three public releases during 1951 "which conclusively and irrevocably without exception condemned all battery additives." Actually, four releases on battery additives were made. * * *

(The document referred to is as follows:)

U. S. DEPARTMENT OF COMMERCE,
NATIONAL BUREAU OF STANDARDS,
Washington 25, January 21, 1952.

Subject: Battery additives.

Mr. JESS M. RITCHIE,
President, Pioneers, Inc.,
2411 Grove Street, Oakland, Calif.

DEAR SIR: I have reviewed carefully your letter of December 13, 1951, with its enclosures and also this Bureau's file of correspondence with the National

Better Business Bureau concerning battery additives. As a result of this review, I transmit the following comments:

1. Your letter questioned a statement used in letters from this Bureau to a number of Senators in response to inquiries stimulated by your organization about the Bureau's work on battery additives. The specific statement is as follows: "We would like to stress again that it is the established policy of the National Bureau of Standards neither to approve nor to condemn any specific proprietary product. Brand-name products are not referred to in publications of the Bureau; materials are identified only by their chemical composition." This quotation, as the second sentence clearly implies, refers specifically to the public dissemination of information by the Bureau. Such implications should have been further obvious since it was used with respect to requests either for approval of your battery additive by this Bureau or for specifically exempting it from published statements by this Bureau about battery additives in general.

The quotation obviously does not apply to the testing activities of this Bureau for other agencies of the Government where approval or disapproval of a product usually is a primary objective of the test. The results of such testing activities are, however, not disseminated to the public unless it can be done without reference to brand name under conditions where the information would be of public interest. Frequently the results of such testing are given to Members of the Congress in response to specific inquiries, particularly when a manufacturer makes claims to the Members of Congress which are contrary to results of the Bureau's tests. The results of the Bureau's tests on brand-name products are also sometimes made available to the courts either in assistance in cases prosecuted by regulatory agencies of the Government or upon court order.

Departures from the Bureau's policy of not releasing directly to the public its test results with respect to brand-name products may occasionally be necessary if a manufacturer circulates false claims concerning the Bureau's tests on his product.

2. Our files show that the bulletin of August 1950 of the National Better Business Bureau on "Battery Compounds and Solutions" was approved by the Director of the National Bureau of Standards prior to its release. This bulletin made specific references to the results of tests by the National Bureau of Standards on Battery AD–X2. The records show that this approval was given after more than 2 years of voluminous correspondence during which period your company had persistently demanded that its battery additive be specifically exempted from previous general releases about battery additives which would have constituted approval of your product by implication. The authorization was justified as an apparent deviation from policy on the grounds that claims made by your organization to the National Better Business Bureau about the National Bureau of Standards tests or lack of tests on your product were not in accordance with the facts.

3. The reports of December 13, 1949, and October 27, 1950, from the University of San Francisco were interesting but cannot be construed as proving Battery AD–X2 to be effective. It is widely recognized that any test aimed at establishing the merits of a treatment process must include fairly selected controls, and there is no evidence that controls of any sort were employed. The absence of controls in the experiences described in the affidavits you transmitted also prevents their classification as proof of the merits of a battery additive.

4. Your letter claims that the National Bureau of Standards made three public releases during 1951 "which conclusively and irrevocably without exception condemned all battery additives." Actually, four releases on battery additives were made, but irrevocable and all-inclusive claims were not made. The major release was Circular 504, "Battery Additives," issued in January 1951. This circular described the results of recent carefully planned and conducted tests on selected types of battery additives and drew conclusions based on these and prior tests. TRG–6.116 was a Commerce Department press release announcing the publication of Circular 504. In the May number of the Bureau's Technical News Bulletin the Battery Additives Circular was described briefly. Such auxiliary releases are substantially routine with any new NBS Circular. An additional memorandum on battery additives was issued on August 28, 1951, to facilitate the handling of correspondence, most of which appeared to have been stimulated by your organization and your distributors.

The test results on battery additives described in Bureau publications are representative of commercial products that have been brought to our attention, and do not claim to be all inclusive. In the event we ever find or have access to an additive material which definitely and conclusively improves the perform-

ance of storage batteries, we will be pleased to revise our publications accordingly. To date we have no valid technical evidence that such a material exists.

5. I hope that the foregoing explanation will clarify what you termed "conflicting epistles and statements." I doubt, however, in view of factual technical information available to us combined with general policy considerations, that we can take any action to satisfy what appears to be your basic demand, namely, that the Bureau issue a statement exempting your product from general conclusions drawn about battery additives.

Very truly yours,

A. V. ASTIN, *Acting Director.*

cc: Senators Douglas, Nixon, Knowland, Lehman, Lodge, Malone, and Dworshak.

Mr. RITCHIE. Insert: On March 15, 1952, a letter from Jess M. Ritchie, to the Director of the Bureau of Standards, explaining claims for Battery AD–X2 and results obtained and claims by customers using the material.

(The document referred to is as follows:)

MARCH 15, 1952.

Subject: Battery AD–X2.

Dr. A. V. ASTIN,
National Bureau of Standards,
Washington 25, D. C.

(Attention: File D.)

DEAR DR. ASTIN: After much thought we will attempt to answer your letter of March 4, 1952.

1. Yes. In many instances Battery AD–X2 is effective after charging has been attempted on sulphated batteries.

(*a*) Batteries that are sulphated to the point that the plates are absolutely inert can be left on any type of charger for sufficient time to give them many thousand times their ampere-hour capacity without damaging them. This is possible because the energy is dissipated between the bus bars which connect the top of the plates. This causes corrosion at the positive bus bar but, since the lead at this point is very heavy, it does not necessarily damage the batteries. Several thousand treatment packages of Battery AD–X2 were used by the United States Marine Corps at Barstow, California, successfully during August and September of 1950, on this type of sulphated batteries. In fact, thousands of batteries in this condition have been treated at various Government Installations with good results. Any battery that has not been charged from a sulphated condition to the point where the grid is destroyed in the positive plate, can be treated with Battery AD–X2 if the separators are in good condition and the battery is otherwise mechanically sound. Battery AD–X2 has been successfully used for the reduction of the lead sulphate crystal in thick-plate batteries such as those used in Fire Alarm Systems and Standby Emergency Plants, after they have been on a low rate of charge for many years and have so sulphated that further use prior to treatment was and could not be expected of them.

(*b*) Batteries with thin grids such as the automotive-type batteries in the University of San Francisco Test, can be treated with Battery AD–X2 and brought to full charge—provided they have not been too severely overcharged. In the case of the University of San Francisco test, a number of attempts were made to charge the batteries without success for better than a year before they were treated with Battery AD–X2. However, the batteries were not sufficiently overcharged to completely deteriorate the grid structure and after treatment with Battery AD–X2 the batteries came to full charge using the same charging current and the same charging equipment. These batteries can be expected to give many months of satisfactory service in the test bench operation, such as the one at the University of San Francisco as the rate of discharge for this type of work is very low. However, if these batteries were put in automotive equipment, their life expectancy would be of very short duration as the grid structure in the positive plate would not be capable of receiving or delivering the high rate of charge and discharge necessary for the operation of a motor vehicle.

(*c*) Our criticism of the test run by your Bureau and other Government Laboratories has been the procedure followed of overcharging, charging, and discharging sulphated batteries to determine their capacity prior to their treat-

ment with Battery AD–X2. The methods used have ruined the batteries prior to treatment. (See letter—Ritchie to Astin, February 16, 1952).

2 (*a*). Yes, exercising a battery—charging and discharging to establish the capacity of the battery prior to treatment, does ruin the battery if the battery is capable of taking a portion of its charge. If it is exercised sufficiently at low rates, it will take a partial or possibly even a full charge from a voltage and specific gravity standpoint. But, the oxigen gas passed at the grid in the positive plate under this condition, forms out the lead grid leaving no mechanical strength to the plate and no conductor for the proper discharge of the battery. The lower the charging rate, the more susceptible the grid of the positive plate to this deterioration, providing sufficient energy is passed to effect the battery at all.

3. We finally located Dr. Randall's test of May 20, 1948. The benefit of Battery AD–X2 could be shown by this test but is less applicable at this time than it was when it was written, as the size of the crosswires in the grid structure has been reduced considerably by the manufacturers since that time. The 5-amp-charging rate, under step 22 of the test, for the 8-hour period, can do considerable damage to the grid of the positive plate, and we have found that it is better to put the treated and the untreated cells on separate charging currents of the same value as the untreated sulphated batteries oftimes do not pass the current well. Dr. Randall expected his readers to understand the lead-acid storage battery considerably better than they actually do.

4. We do not claim that Battery AD–X2 has any effect on a lead-acid storage battery other than the prevention and reduction of sulphation. However, the prevention of the formation of the minutely soluble sulphate crystal has far-reaching effects on the overall operation of the lead-acid storage battery. (See the following:)

Letter Ritchie to Astin, Feb. 25, 1952
Lohry letter—Form 90
Bender Affidavit
Dinwiddie letter
California Tractor & Equipment
Bay Equipment—Little Affidavit

5. Our enclosed test dated June 1, 1951, will demonstrate the beneficial effects of Battery AD–X2 in the lead-acid storage battery, as well as the weakness of previous test run by the National Bureau of Standards and other Government Laboratories. It also outlines the method of determining when a battery is sulphated, the degree and type of sulphation which occur in a lead-acid storage battery would require a book-length document to explain. Therefore, we ask that you take our explanation as outlined in our Test Procedure as of June 1, 1951.

6. The crux of the entire discussion for the past four years with the Bureau of Standards lies in these lines of your letter—"that is, batteries, which are left untreated throughout the test, are of approximately the same quality prior to the test as the batteries treated with the additive, and are subjected to the same conditions throughout the test as the treated batteries." This is outlined in our Test Procedure dated June 1, 1951. When this is done, the question will resolve itself in a ten-day period from the beginning of the test.

We would like to say here that we realize that you have in the past been guided by the material passed on to you by your predecessors and more recently by your associates in the Electrochemistry Section, on the subject of Battery AD–X2. We respectfully request that due to personal feelings which have been created between this organization and personnel in the Electrochemistry Section, that no one in the Electrochemistry Section be permitted to attempt the enclosed test or to influence or discuss in any way, the subject as it now stands. We further request that a Chemical Engineer, preferrably one who is familiar with Thermodynamics, be assigned to the project. We wish this for two reasons. 1. Heat has a tremendous effect on the lead acid storage battery; and, 2. This is purely a a chemical problem.

7. We arrived at the 70 percent for battery failures due to sulphation, by dismantling and inspecting initially 1,600 batteries. Taking a cross section of batteries which had failed from Alaska, Guam, Hawaiian Islands, the Mountain Sections, The San Joaquin Valley and the Bay Area of California. Actually, of the 1,600 batteries inspected, there were only 19 which had failed for any reason other than sulphation. Dr. Randall, being of a very conservative mind, suggested that for advertising purposes, we use 70 percent. However, our operations over the past four years, covering a good portion of the United States

and many foreign countries, has necessitated our dismantling several hundred thousand batteries to obtain elements for processing under the Battery AD–X2 Service System. In studying these plates, we still find no reason for not believing that very close to 100 percent of all battery failures in the lead-acid battery is caused directly or indirectly from sulphation. (See letter Ritchie to Astin, February 25, 1952.)

The undersigned would be glad to make a trip to your Bureau for the purpose of selecting batteries, assisting and setting up the test and discussing the subject thoroughly with you or any Chemical Engineer whom you might see fit to designate to handle the problem.

In closing, we would like to say that in conversations with people in Washington, D. C., we have arrived at the conclusion that you will be fair with us and that is all we ask. Resolving our controversy on Battery AD–X2 with the National Bureau of Standards will mean a great deal to the public and the Nation as a whole.

The treatment of lead-acid batteries with Battery AD–X2 will allow years of storage without having to handle the batteries for recharge. It will insure people of batteries that will take a full charge without damaging the batteries where it is necessary to ship batteries long distances.

Battery AD–X2 has given our customers better than double the life expectancy when used in the present day storage battery. It will enable our military to salvage thousands of batteries which have sulphated in transit or in storage. Treating batteries with Battery AD–X2 will permit the battery to operate for a much longer period at its peak capacity than can be expected by the present day untreated battery which begins sulphating the day it is manufactured and continues to gradually lose its capacity to sulphation until the capacity is no longer sufficient for the battery to function at all.

We are enclosing a copy of the paper on Battery AD–X2 which was read by Dr. Randall before the American Chemical Society in 1949. We ask that this too, be passed on to the Chemical Engineer whom you may designate to handle the project.

We are also shipping to you, under separate cover, 1 dozen treatment packages of Battery AD–X2. Analysis of Battery AD–X2 will disclose that there has been substantial changes in the salts contained therein, which results in a third ingredient which, to the best of our knowledge has not been contained in any previous so-called battery additives. So far this fact has apparently been overlooked by the National Bureau of Standards.

Very truly yours,

PIONEERS, INC.,
JESS M. RITCHIE,
President.

JMR: V
encls: 8
cc: Senator Nixon

Mr. RITCHIE. Insert: Critcisms of Letter Circular 504, dated May 1952, by both Guy F. Wetzel, editor of Battery Man Publishing Co. and Keith J. Laidler, assistant professor of chemistry, Catholic University of America.

(The documents referred to are as follows:)

COMPARATIVE PERFORMANCE TEST OF BATTERY AD–X2

By Guy F. Wetzel (nom de plume, George F. Wesley)

In the October 1948 issue of the Battery Man (magazine), in answer to a subscriber who inquired about the use of reclaimed oxides and "battery dopes," I stated as follows:

"In regard to this preparation which we assume is sold to improve or increase the life of batteries, we will repeat what has been said before a number of times in these columns, that there is no preparation whatever on the market that is accepted as of value in improving or increasing the life of batteries."

I was skeptical of all battery additives I had heard of previously because salts added to a battery, particularly magnesium sulfate, while they helped in desulfating a battery due to the addition of foreign ions, the beneficial effect is ordinarily of short duration. It can be accepted that the grid may become coated, particularly the negative grid, and a very high rate of shedding will normally be expected because of the addition of these salts.

Under date of January 6, 1949, I received a letter from Dr. Merle Randall, of Randall & Sons, chemical and chemical engineering consultants, forwarded to me by O. W. Prendergast, editor of the Battery Man magazine, calling my attention to Battery AD–X2, which was previously unknown to me. This letter follows:

RANDALL & SONS,
CHEMICAL AND CHEMICAL ENGINEERING CONSULTATION,
2512 ETNA STREET,
Berkeley, Calif., January 6, 1949.

Subject: Answer to article, Reclaimed Oxide, October 1948.

The BATTERY MAN,
2770 South 13th Street, Terre Haute, Ind.
(Att: O. W. Pendergast, Editor.)

DEAR SIR: Your discussion of "battery dope" preparations is not in accord with the results attained by the use of a relatively new additive about which you probably have had no former notice. I enclose an announcement of AD–X2 which answers many questions about the product. The claims of Pioneers, Inc., are really conservative. They have dealt, for the most part, not with small firms or individual battery owners but rather with large firms with excellent cost records and intelligently managed and well-equipped maintenance shops. For information about the writer, please refer to Who's Who in America, American Men of Science, etc.

Specifically AD–X2 does lengthen the life expectancy of lead-acid batteries. If the life of a battery is lengthened by 50 days, the treatment will pay for itself in direct item costs. The additive gives most spectacular results with mechanically sound sulfated batteries.

In batteries treated with AD–X2 the active material in the plates is converted to a soft pliable form, which is much less destructive to the insulators than is hard crystalline sulfation. The active material remains in firm contact with the grid, the electrolyte remains clear. There is actually some evidence of a decrease in battery mud in treated batteries that have been in service, especially on mobile equipment, for some months. Pioneers, Inc., make no claim about this, however.

Because the active material is tight to the grid, there is less decomposition of water during charge. After charge is complete the discharge of bubbles takes place over the entire surface of the plate, rather than in the immediate vicinity of the grids as in untreated batteries after they have been in service for some time. This lowered decomposition of water and the lower resistance between the active material and the grid, because of its tightness to the grid, results in a less loss of water from the electrolyte of the AD–X2 treated battery. Again, Pioneers, Inc., do not stress less loss of water.

Because the active material remains soft the breakage of cases due to sulfation and buckling of the plates is negligible. Because gassing takes place over the entire surface of the plate on overcharge, there is less corrosion of the positive grid. Because the positive grid contains antimony there is thus less antimony in the electrolyte. Less antimony in the electrolyte means less self-discharge of the negative plate, etc. Thus development of mechanical defects is effected by the additive.

It is my observation that at least 70 percent of battery failures result from sulfation. One of the cheapest and most practical means of testing the mechanical soundness of a battery which will not take and hold a charge is to treat the battery with AD–X2 and put it on the regular charge cycle or place the battery in normal use. If the battery is mechanically sound, it will quickly respond and take its charge.

The battery manufacturers are not familiar with AD–X2. With the ever-present shortage of lead they will soon be quite willing to see that the user gets a longer life and more certain service from his battery. I feel that you should publish a statement somewhat along the enclosed copy.

Pioneers, Inc., conduct their business in accordance with the ethics of the National Better Business Bureau. They guarantee their product, and carry product insurance.

Very truly yours,

RANDALL & SONS,
(Signed) MERLE RANDALL.

MR: ab

Because of the sincerity and apparent technical soundness of this letter, I wrote to Pioneers, Inc., Oakland, Calif., for samples of their Battery AD–X2 so that I could make some tests on it myself. Due to the pressure of other matters, it was not until November 1949 that I got around to using the material.

I had four old batteries in my shop at Lane Technical School which were so sulfated that they would not take a charge. These batteries were at least 4 years old and had been used by the students intermittently to start shop engines unil they became unusable. These batteries were all group II. They were: 2 Willard batteries, 1 Exide, and 1 Volta battery.

These batteries were treated with Battery AD–X2 in accordance with the instructions sent with the material and were put on charge at 6 amperes for 24 hours. Much to my surprise, three of the batteries took a charge and came up to almost normal gravity. None of these batteries had been opened up to determine their mechanical condition. Probably because the positive grids had been so oxidized from previous charging or other mechanical defect, the Volta battery refused to take a charge.

Before charging, each cell was tested for specific gravity and open-circuit voltage and the condition of the cells before and after treatment recorded, as given in the following table:

(NOTE: The batteries are designated as W I, W II for the two Willard batteries, E for the Exide, and V for the Volta.)

Battery Tests

BEFORE TREATING

Battery	Cell	Gravity	Voltage (open)
W I	Positive	1.010	0
	Center	1.015	0
	Negative	1.010	0
W II	Positive	1.110	.5
	Center	1.110	.5
	Negative	1.110	.3
E	Positive	1.115	.3
	Center	1.110	0
	Negative	1.125	.2
V	Positive	1.115	.5
	Center	1.110	0
	Negative	1.115	.3

AFTER TREATING

W I	Positive	1.270	2.1
	Center	1.267	2.07
	Negative	1.272	2.11
W II	Positive	1.275	2.13
	Center	1.275	2.13
	Negative	1.272	2.11
E	Positive	1.265	2.0
	Center	1.270	2.1
	Negative	1.268	2.08
V	No charge		

NOTE.—The room temperature during charge was 72° F. and the batteries stayed within 10° of the room temperature during the charging cycle.

After charging at 6 amperes for 24 hours the batteries were allowed to stand from 24 to 72 hours and then tested for discharge capacity by loading them one at a time with a bank of headlight bulbs drawing a total of 13 amperes. The batteries were rated 120 ampere-hours each. The results of the discharge tests were as follows:

W I, time 7 hours, equivalent to 91 ampere-hours.

W II, time 6 hours, 15 minutes, equivalent to 81 ampere-hours.

E, time 5 hours, 45 minutes, equivalent to 74 ampere-hours.

These batteries were so badly sulfated that the resistance in ohms was greater from plate to plate than was the resistance in ohms from the negative crossbar plate ears to the crossbars on the positive plate ears, so that the current was being passed from crossbar to crossbar prior to treatment and would take no useful charge.

I did not consider it necessary or advisable to leave any of the batteries untreated for comparison because they were so totally unusable before the treatment.

Another instance was in connection with the battery which was in my 1950 Dodge car, an Auto-Lite 110 ampere-hour battery, which I treated shortly after I purchased the car in December 1949. This battery gave good service until August 1950 at which time the battery failed.

In order to determine the cause of failure, the battery was sent to Pioneers, Inc., at Oakland, Calif., for dismantling and inspection. It was found that the plates were in excellent condition but that the separators had deteriorated and caused the battery to fail. Nothing was done to this battery except to install new Port Orford cedar separators, reassemble, and charge it. It was returned to me and put in the car once more. The 1950 Dodge was turned in on a 1952 Dodge, but the same battery was retained and put in the 1952 Dodge in place of the new one to see just how long this battery would last. At the present time, May 12, 1952, it is operating in a perfectly normal manner after almost 30 months, and tests run on the battery indicate the following:

Auto-Lite Battery

Cell	Gravity	Open-cell voltage	Breakdown voltage
Positive	1.270	2.10	3 cells, 1.9 volts each discharge at 300 amperes, 30 seconds.
Center	1.280	2.20	
Negative	1.272	2.12	

In July 1951 I made a trip to the west coast and spent 2 days in the shop of Pioneers, Inc., at Oakland, Calif. Based on my observations and previous experience with Battery AD–X2 the following two articles were written and published, respectively in the September 1952 and October 1952 issue of The Battery Man.

A few weeks ago I returned from a visit to the west coast. Among other places where I stopped I spent 2 full days with Jess M. Ritchie, the president of Pioneers, Inc., in Oakland, Calif. This corporation, as some of you may recall, makes Battery AD–X2, the only battery additive to my knowledge that accomplishes everything the maker claims it does. Also, bear in mind that the product was developed by Ritchie under the guidance of Dr. Merle Randall, professor emeritus in chemistry, of the University of California and considered a top authority in this field.

The subject of battery additives has been pretty well covered and they are generally condemned by the National Better Business Bureau and the United States Bureau of Standards. However, neither of these organizations has tested Battery AD–X2 consistently in accordance with methods that will give results comparable to those obtained in actual practice. Therefore, they are not qualified to pass on the merit of this material which is far different from the usual battery dope.

There is a very inconsistent situation existing in connection with the better business bureaus. To check this personally I phoned the general manager of the Oakland Better Business Bureau and asked about the reputation of Jess M. Ritchie and Pioneers, Inc. The better business bureau manager went to considerable length to tell me that Ritchie and Pioneers, Inc., enjoy a very fine reputation as high-grade operators and that the bureau has never had one complaint from customers of Pioneers, Inc., or any other party.

To try to do justice to the company the Oakland Better Business Bureau sent a bulletin, a copy of which I saw, to all the other local better business bureaus in the country stating that Pioneers, Inc., is a high-grade, reputable business concern and that their product, Battery AD–X2, is liked and used with excellent results in and around Oakland and that good reports have come in from satisfied users in many parts of the country with no complaints from any source.

Newsweek, which is an influential, high-grade weekly news magazine with a national circulation, ran an article in the December 11, 1950, issue, entitled "New Life for Batteries," devoting a full page and a half to the story of Ritchie and Pioneers, Inc. It mentions the way Battery AD–X2 was discovered and gives the names of a number of enthusiastic users of the material. The science editor of Newsweek spent 4 days in Oakland getting the information needed to enable him to put the article together.

Battery AD–X2 is primarily a sulfation preventative and desulfating agent for mechanically sound batteries. It is claimed to be nothing more. No claims are made that the material will charge batteries, or will increase their power beyond Farraday law, eliminate the need for charging nor give the batteries new zip and power (unless they are sulfated, in which case they must be mechanically sound and normally charged), as is claimed falsely by the type of battery dope that the Bureau of Standards and the National Better Business Bureau are condemning.

The fact that Battery AD–X2 is a sulfation preventative and desulfating agent is what gives it its remarkable value. To understand and appreciate this, it is necessary to understand how batteries fail due to sulfation deterioration.

Battery men generally consider a battery sulfated when hard white crust forms on the plates. They fail to recognize the fact that there are several different kinds of sulfation. In the normal operation of a battery giving off electrical current lead sulfate is formed in the active material of the plate. When the battery is charged this sulfate is converted back into lead peroxide on the positive and sponge lead on the negative plates. But as a battery becomes older and is in more or less intermittent use, what Dr. Merle Randall calls minutely soluble sulfate gradually forms which looks much like the usual reddish brown active material on the positive plate but is harder and feels more slatey. As the amount of this kind of sulfate gradually increases, the plates gradually lose their power to take and hold a charge and the cell will finally fail. One bad cell in a battery means the battery is also a failure.

The bad feature of this sulfate is that the adhesion of the active material to the plate grids is very poor. This leads to oxidation of the metal of the positive grids, that is, actual formation of the metal into lead peroxide in the same way the early Planté plates were formed from sheets of metallic lead. In the negative plates the paste becomes loosened from the grid through gassing between the grid and the active material when the active material consists of the hard minutely soluble sulfate.

The big well-known battery makers have issued bulletins stating that one of the principal causes of battery failure is oxidation of the positive grids due to overcharging. Actually the main cause of the grid oxidation is due to poor contact of sulfated active material with the grid. Thus the charging current not being able to fully convert the sulfated active material, goes to work on the grids and converts them or forms the material into lead peroxide. This, of course, weakens the grid structure as well as its current-carrying capacity which puts the cell out of commission.

Here is where the value of Battery AD–X2 comes in. Its action is to convert the sulfated active material to a softer material which tightly adheres to the grids protecting them from oxidation and giving good electrical contact between the paste and the grid material. That this is true is proven by tests in which Battery AD–X2 treated batteries have been given 2,000 percent overcharges time after time with no harmful effects. This is only one of the evidences that this remarkable material really does accomplish very favorable results and results that lead to greatly reduced battery expense through longer life expectancy.

If a doctor is willing to take his own medicine, you can be very sure that it is pretty good medicine. Next month I will tell you how Ritchie uses his own product to turn out guaranteed rebuilt batteries and produces a generous profit at the same time.

DOING THE IMPOSSIBLE

One of the famous generals who helped to make military history for us once said, "The difficult task we do at once. The impossible takes a little longer." This would imply that some things which are generally considered to be impossible of accomplishment can be done, after all. For example, in 1925 if you had been told that you could sit in your living room and watch and hear events taking place a thousand miles away, by means of a device called television what would you have said? It would probably have sounded something like "Nuts."

In this year of 1952, if you were told that regardless of how badly positive and negative battery plates are sulfated, if the grids are mechanically sound, they can be put into a case, properly connected, and the resulting battery can be guaranteed for a full year on a basis of money back or another battery without charge, what would you say? Probably the same thing—"Nuts."

But just as truly as you can watch television programs (if you are within range of a TV station) are such batteries being put out by a number of shops

scattered from Oakland, Calif., to Boston, Mass., following the procedure developed by Pioneers, Inc., of Oakland, Calif., and treating the batteries with Battery AD–X2.

Battery additives have had a bad name, and are generally condemned by the Bureau of Standards of our Government, and by the National Better Business Bureau. But I definitely state, with full consciousness of the importance of such a statement, Battery AD–X2 is one additive that does even more than the maker claims for it, and that it makes the unbelievable happen in electric storage batteries.

The material—called Battery AD–X2—contains some of the same chemicals that are used in ordinary battery "dopes." But, in addition, it contains a catalyst that is the causative factor which brings about the amazing results that are accomplished. Some of these results upset long-accepted principles in the battery-building and servicing business, and made practicable the salvaging of from a third to two-thirds of the batteries which fail in service, with no loss of precious lead, which is becoming increasingly scarce. These batteries are put back in service, and in most cases perform better than new batteries, with a longer service life.

I have personally inspected three battery-reprocessing shops—in Oakland, Calif., Sacramento, Calif., and Grand Rapids, Mich.—where reprocessed batteries are turned out, using only material selected from batteries which have failed or have been junked, except for new separators of Port Orford cedar, and treatment with Battery AD–X2. These batteries are consistently giving satisfaction in fleets, police cars, contracting equipment, electric tractors and fork-lift trucks, marine service, standby plants, etc., and are cutting battery costs from 40 to 70 percent, with an average of better than 50 percent. This is done by cutting down time, giving increased output, reducing service failures, as well as some reduction in selling price as compared with new batteries.

A natural question that will be coming to mind by this time is, "What is done to these batteries to make them give such excellent service?" Here is the answer.

For every reprocessed battery that is sold, an exchange battery is required and, in addition, junk batteries are bought and wherever possible new shelf-sulfated batteries are taken in. These batteries are all opened up and every element is carefully inspected. Where 80 percent or more of the active material is left on the grids, and the grids, especially the positive, are in good mechanical shape, regardless of the sulfation that may be present in the active material, the groups are used. All separators are discarded and the groups reinsulated with Port Orford cedar separators. The battery boxes are carefully checked for leaks and, as far as possible, all composition cases are rejected, using only hard rubber cases. The elements are recased, covers put in place, new straps and posts burned on, the original acid poured back, a treatment of AD–X2 put in each cell, and the battery put on charge. It is kept on the charging line at a rate of 5 amperes for 24 hours, then 1 ampere per positive plate until successive hydrometer readings an hour apart show no increase in gravity. Each cell must come up to 2.5 volts under charge. Any batteries which do not come up to 2.5 volts per cell are taken off the line and opened up again to find out why.

When the batteries are taken off the line, they are allowed to stand for 24 hours and then are required to give 300 amperes for 15 to 30 seconds with no 3-cell voltage below 4.2. Batteries which go through all this go into service, and an average of 95 percent of them stay in service far beyond the guaranty period of a year. This is much better than the average for new batteries which are on a prorated warranty with a charge for months of service.

The AD–X2 material reduces even badly sulfated active material, on both negative and positive plates, to soft, porous, effective active material which adheres strongly to the grids. The rejuvenated active material stays that way for the life of the battery, with very little shedding and no sulfate which forms as a battery becomes discharged and which is reconverted to lead peroxide and sponge lead, respectively, as the battery accepts a charge.

It is not generally recognized that there are numerous types of battery plate sulfation. The one that most commonly forms in batteries that are used only 1, 2, or 3 days a week, or may stand unused for days or a week or 2, looks much like normal active material, but is what Dr. Merle Randall, famous battery scientist, called "minutely soluble sulfation"; that is, it is only slightly soluble and, therefore, only slightly active. It has very poor adhesion to the metal of the grids, and this makes a high-resistance contact, and promotes oxidation, or formation, of the metal of the grids. As this sulfation increases in amount, the

battery becomes weaker, until when heavy demands, such as winter starting, are put on the battery, it can't deliver and must be replaced.

The soft, treated, active material, resulting from the use of AD–X2, adheres strongly to the grid metal, making the internal battery resistance a minimum, and keeping the battery temperature down. This makes it almost impossible to damage the battery from overcharging with a moderate current.

Space prohibits telling you of many more actions of the storage battery treated with this additive which make it perform as it does. But I have personally seen them happen and have checked performance of a number of reprocessed batteries turned out under this system. So when the statement is made that here is definitely something new and important in the storage battery service line, it is true.

Another experience with a battery for the confirmed value of Battery AD–X2—we have a snowplow at the Lane Technical High School, which is only used, naturally, during the winter weather. The battery in the snowplow had received no attention from the previous winter and was found to be in a totally discharged condition in October 1951. It was brought to my shop to be charged and, after leaving it on charge for 18 hours at 6 amperes, it was found that it would not take a charge. The battery was treated by me with Battery AD–X2 in accordance with the maker's instructions and was once more put on charge with 6 amperes. After a 24-hour charge it was found that the gravity came up to 1.280 in each cell.

In order to be sure that the battery had capacity that would make it usable once more in the snowplow, it was discharged, using the same bank of headlight bulbs previously used at the 13-ampere rate. The discharge was maintained for 7 hours which would be equivalent to 91 ampere-hours at the 13-ampere rate, or relatively equivalent to 110 amperes at the 20-hour rate. The battery is a group II, rated at 120 ampere-hours. The battery was charged again and turned over to the maintenance department of the school for use in the snowplow and started the snowplow engine satisfactorily during the 1951–52 winter season.

A test run on the battery at this date, May 12, shows the following:

Snowplow battery as removed

Cell	Gravity	Open-cell voltage	Breakdown voltage
Positive	1.240	2.12	Breakdown 1.8; discharge at 200 amperes, 30 seconds; terminal voltage 5.40; temperature 70° F.
Center	1.240	2.11	
Negative	1.230	2.09	

Snowplow battery after 5-hour charge at 6 amperes

Cell	Gravity	Open-cell voltage	Breakdown voltage
Positive	1.280	2.2	1.90 volts per cell; discharge at 200 amperes, 30 seconds; terminal voltage 5.70; temperature, 85° F.
Center	1.280	2.2	
Negative	1.270	2.18	

Until I became familiar with AD–X2, I was firmly convinced that no battery additive had any value in connection with improving the performance or life of storage batteries. However, the various experiences I have had with Battery AD–X2 have convinced me that this material does have definite advantage in increasing both the performance and life of lead-acid batteries. My experience shows that the material fulfills every claim that the manufacturer makes for it and, in fact, their claims for the material are quite conservative.

The material contains magnesium sulfate and sodium sulfate, which is generally agreed in themselves are of little value as battery additives, but the catalyst that is incorporated in the material apparently is the element that makes Battery AD–X2 an entirely different product from all the other battery additives that have been foisted on the public at various times.

I have observed the Pioneer, Inc., method of rebuilding batteries in shops in Oakland, Calif., Sacramento, Calif., Grand Rapids, Mich., and Chicago, Ill., and in each case I found the shop operators are doing a very good job of battery rebuilding, but the badly sulfated plates in mechanically sound grids could not

possibly have turned out high-capacity batteries without the use of Battery AD–X2.

I have seen these batteries tested and in operation and my observation indicates that they are superior to new batteries, which could not have possibly been accomplished, either by the manner in which they are rebuilt, or by the use of magnesium sulfate and sodium sulfate alone. The rebuilding methods in no way indicate or account for the outstanding service rendered by batteries treated with AD–X2, but depend principally upon the use of this material.

I have looked over the circular letter No. 504 put out by the National Bureau of Standards and I fail to see any tests that were run in accordance with the tests determined by Pioneers, Inc., to actually demonstrate the value of Battery AD–X2.

Overcharging batteries, particularly sulfated batteries, merely expedites the oxidation of the positive grids so that if they were not ruined before the tests, the test itself would complete their destruction.

Furthermore, great stress is laid on the lack of value of magnesium sulfate and sodium sulfate as battery additives, which is true. However, Battery AD–X2 is entirely a different material, due to the addition of the catalyst, and this is what gives it the remarkable ability to soften active material, dissolve sulfidation, improve the adherence of the active material to the grids, and increase the battery capacity.

In addition to my own experience and observation in connection with Battery AD–X2, I have talked to battery rebuilders using this material from many parts of the country, from Florida to Idaho and from California to Massachusetts, and they are enthusiastic about the results they have achieved in rebuilding batteries of sizes from group I to large batteries used in fork trucks, mine locomotives, and powerplant standby batteries.

Therefore, it is my carefully considered opinion, based on tests and personal observation, that Battery AD–X2 should be definitely differentiated from other battery additives, or so-called "battery dopes" and considered as a valuable material which will save American motorists millions of dollars and be an important factor in the conserving of lead supply.

A Critique of the National Bureau of Standards Circular No. 504 on Battery Additives With Special Reference to "Battery AD–X2"

(By Keith J. Laidler, Ph. D.)

A. STATEMENT OF PROBLEM

I. Battery additives are materials designed to be added to the electrolyte in lead-acid storage batteries for the purpose of extending the useful life of such batteries.

II. One particular additive, "Battery AD–X2," has been claimed by numerous technicians, and has been demonstrated by various tests, to be extremely effective when applied to batteries in sound mechanical condition, even if they are highly sulfated and consequently impossible to charge.

III. In disagreement with this, the National Bureau of Standards, in Circular 504, reports on tests made on several battery additives, and the reader is left with the impression that no battery additives on today's market performs any useful function; the particular additive "Battery AD–X2" has been condemned by name in correspondence of the Bureau of Standards as being worthless in extending the lives of batteries.

IV. The Bureau states that all additives described in No. 504 were "combinations of anhydrous magnesium and sodium sulfates." "Battery AD–X2" is not a simple combination of the two sulfates specified.

B. SUMMARY OF CONCLUSIONS

I. The tests described by the Bureau in No. 504 do not permit a valid scientific conclusion to be drawn that the battery additives tested served no useful purpose for the following:

(*a*) The tests were not adequate since they were made on batteries of undetermined condition which may well have been mechanically unsound;

(*b*) Adequate controls were not maintained.

II. Since "Battery AD–X2" is not simply a combination of magnesium and sodium sulfates, it is not clear that the Bureau ever tested "Battery AD–X2" at all. Even if the Bureau did test "Battery AD–X2" using the test procedures described in No. 504, no valid scientific investigation of "Battery AD–X2" was made by the Bureau.

III. Circular No. 504 of the National Bureau of Standards fails to give fair conclusions regarding battery additives in general.

C. DISCUSSION

The additive "Battery AD–X2"

The additive "Battery AD–X2" has been stated by large numbers of experienced technicians to be extremely effective in preventing sulfation in storage batteries, and also in restoring old but mechanically sound batteries to effectiveness. No claim is made that mechanically unsound batteries respond to treatment by the addition of this substance; this is important in connection with the nature of the tests conducted by the National Bureau of Standards (see below).

The Bureau has conducted tests on certain battery additives, consisting of various mixtures of sodium and magnesium sulfates. They conclude from these tests that these substances are not effective, and in Circular No. 504 they strongly condemn the use of additives. Whether or not their tests included Battery AD–X2 is not clear, and is discussed below; however, in a communication to the National Better Business Bureau (August 1950) they include Battery AD–X2 among the substances they have tested, and claim that it has no effectiveness.

There is clearly a sharp discrepancy between the conclusions of many experienced battery technicians and users and those of the Bureau of Standards. In this report, the reason for this discrepancy is examined carefully, and it is concluded that the tests conducted by the Bureau do not justify their statement that battery additives in general, and Battery AD–X2 in particular, are ineffective in combating sulfation.

The efficiency of Battery AD–X2

The present writer has examined the letters and affidavits of a large number of persons who have in many cases carried out extensive tests on Battery AD–X2. In all cases their conclusions were highly favorable to the product.

In the past, as is shown by correspondence I have examined, the Bureau has discounted statements similar to these by saying that the authors of them were deceived by the phenomenon of battery regeneration, by which is meant that a battery which has become discharged will (owing to diffusion effects) become again active after a short period of time. It is certainly possible that some private car owners might be deceived by unscrupulous exploitation of this effect. But it is wholly unreasonable to assert that battery technicians and trained scientists could have been hoodwinked in this way. In the first instance, experienced battery technicians could not fail to be aware of the phenomenon of regeneration, which is a very well-known effect and one which many motorists have discovered themselves. Secondly, most of the persons who have written about Battery AD–X2 had previously tried other battery additives, and had found them to be useless. It can hardly be supposed that the battery regeneration comes to the aid of Battery AD–X2 but not of other additives. The main point is that regeneration is a temporary phenomenon, and has no bearing on the overall longevity of a battery.

The writer has also carried out himself a simple, but highly convincing, demonstration of the effectiveness of Battery AD–X2. This was done on a 6-volt automobile battery which had been standing for many months in an uncharged condition, and which had been placed on the charger a number of times, without success. Before the addition of the Battery AD–X2 the hydrometer readings on all cells, and the voltmeter readings, indicated the battery to be completely uncharged. The battery was then tested with the additive according to manufacturer's instructions and connected to a tungar charger. After about 6 hours it was found that 2 of the cells showed hydrometer readings corresponding to full charge while the third corresponded to no charge. The voltage of the battery at this time was 5.8 volts. The fact that one cell failed to charge shows that the regeneration is a real effect; it was noted that the cell which failed to charge was badly buckled.

The battery users referred to above experienced continuing improvement after using Battery AD–X2 and were able to reduce their battery costs by a very large proportion.

It seems, therefore, impossible to avoid the conclusion that the use of Battery AD–X2 brings about a marked increase in the life expectancy of a battery.

The National Bureau of Standards tests

In Circular No. 504 issued by the Bureau of Standards, tests on five different battery additives are described in detail, the additives consisting of sodium sulfate and magnesium sulfate mixed in various proportions. The circular states in its preface that it is written for the "average automobile owner and storage battery user." This is highly flattering to the above individuals, who, in the present writer's opinion, would be in no way qualified to understand or assess the significance of the tests described. It is difficult to avoid the conclusion that the object of Circular No. 504 was to discourage the average reader from using battery additives by the use of highly technical arguments which would be incomprehensible to him rather than to be informative, objective, and educational.

There are several other features of the circular which force one to conclude that the authors were more concerned with justifying their own preconceived notions as to battery additives rather than reporting objective conclusions. Superficially the tests described appear very well organized, and would probably so impress the average automobile owner, but a closer examination of these tests reveal several very peculiar and unsatisfactory features. The following points are especially worthy of note:

(1) The manufacturers of Battery AD–X2 have made it clear that their product naturally cannot be expected to revive batteries of unsound mechanical condition. In spite of this, the Bureau tests were carried out on batteries that in all probability were in a mechanically unsound condition. The batteries used had stood for 4 years in a charged and damp condition, and were given a 388-ampere-hour charge. Since the batteries were 120-ampere batteries and were badly sulfated, this represents a very high degree of overcharging, and must inevitably have brought about considerable mechanical destruction. In view of this the tests described do not constitute a fair or objective trial of the additives under the conditions corresponding to those referred to in the manufacturer's claims.

(2) Another curious feature of the tests is the fact that instead of adding water to the batteries, as should have been done, the Bureau staff added sulfuric acid of 1.05 specific gravity. As a result of this and specific gravities of the batteries after charging were not far from 1.280 the value for a new battery, a fact that will trap the average automobile owner who reads the circular into believing that the batteries tested were in good mechanical condition and practically fully charged. Had water been added the specific gravity of the electrolyte would have been lower by about 0.050 and it would have been readily apparent that the batteries were in poor condition.

(3) Throughout the tests conducted by the Bureau, an important factor in the evaluation of the batteries was the hydrometer readings of the different cells at different stages of the test. Since at the outset of the tests sulfuric acid, as opposed to distilled water, was added to the batteries in order to achieve the proper electrolyte level, the meaning of such measurements is open to serious question, particularly since the acid will have an undetermined effect on the process of desulfation.

In addition, the tests would only be significant if for comparison they have also been carried out on new batteries which had been treated with surplus sulfuric acid. It would also appear essential to carry out comparative tests on new batteries which had been proportionately overcharged in the same manner as the six test batteries used. This technique of carrying out comparative tests on a standard is regular practice, but is conspicuously lacking in the Bureau tests here considered.

SUMMARY

I. In view of the above points the present writer considers that the Bureau tests described in Circular 504 are definitely not adequate or fair, and that they do not justify the conclusion that the battery additives investigated are of no value.

II. In any case, of course, the tests described in Circular 504 do not determine the question of whether Battery AD–X2 is effective as an additive in view of the conclusion that Battery AD–X2 was not used in the tests described in this

circular. The Bureau does claim, however, to have investigated Battery AD–X2 so that the above discussion is important in connection with the type of testing that the Bureau apparently considers to be adequate.

III. We now come to the final and most important matter for present purposes: Did the Bureau test Battery AD–X2 at all? Consideration of this question reveals a very puzzling unsatisfactory point. It is quite certain that none of the additives referred to in Circular No. 504 (table 2) was Battery AD–X2 since the five additives listed there are stated (on p. 7) to be "combinations of anhydrous magnesium and sodium sulfates." Two of the mixtures (A and C) are stated to be commercial products but neither can be Battery AD–X2, which is not a simple combination of these two sulfates.

In an official communication (dated April 5, 1950) to the National Better Business Bureau, the Bureau of Standards reiterates its position with regard to mixtures of magnesium and sodium sulfates. They then go on to say that Battery AD–X2 was included in their tests, and was shown to be ineffective. Now the tests referred to in this communication, although not stated to be the tests described in Circular No. 504, have a very marked resemblance to those tests, even to the numbers of batteries under test. There is, at least, a very strong implication that the same set of tests is being referred to, and the average reader would certainly conclude this, and would assume that either additive A or C was Battery AD–X2.

This is obviously a very confusing and unsatisfactory situation, which the Bureau of Standards should clarify. They should state explicitly whether the tests referred to in their April 5, 1950, communication to the National Better Business Bureau were the same as those described in Circular No. 504. If so, they should admit their error in describing "Battery AD–X2" as a mixture of the two sulfates; if not, they should publish details of their tests so that they can be properly assessed by outside scientists. Otherwise suspicion and mistrust are inevitable, and the manufacturers of "Battery AD–X2," its potential users, and the Government itself, will suffer.

CONCLUSION

An evaluation has been made of the battery additive "Battery AD–X2" and of the various tests carried out on it.

It is concluded that there is a very strong case in favor of the effectiveness of this substance in preventing sulfation in storage batteries. This case is based on (*a*) adequate scientific tests; and (*a*) on the general experience of many experienced battery users.

The tests carried out by the National Bureau of Standards have been examined, and it is concluded that they were conducted under conditions which no additives could be given a fair trial, since the tests most probably involved mechanically unsound batteries and were made without proper controls. Furthermore, there is no doubt as to the nature of the tests, if any, made on "Battery AD–X2" and their results. It is suggested that the Bureau withdraw Circular No. 504 in the public interest.

MAY 15, 1952.

Mr. RITCHIE. Insert: Testing procedure for Battery AD–X2 (suicide test), dated June 1, 1951, forwarded to Acting Director of Bureau of Standards, by request of March 15, 1952, from which we quote:

Should the specific gravity of any battery go above 1,280 specific gravity with temperature corrections during the above-outlined charge, acid should be drawn off and acceptable water added to lower the specific gravity to slightly below 1,280.

Again quoting:

Tabulate and compare the amount of water added to the treated and untreated batteries.

Again quoting:

Take voltage, hydrometer, and temperature readings.

(The document referred to is as follows:)

PROCEDURE FOR TESTING BATTERY AD–X2 (SUICIDE TEST)—JUNE 1, 1951

Choice of batteries.—Group 1 or 2 automotive type lead-acid batteries.

1. Batteries selected should be shelf-sulfated [1] lead-acid batteries which have not been charged by trickle charging or any other method of charging which would affect their mechanical soundness from the time they were formed. These batteries are available through battery distributors or from war surplus; or

2. Dry-charged [2] or moist-charged batteries should be selected which are beyond their date limit for putting into service, which may or may not have been filled with electrolyte but which have not been charged.

3. Twenty-one batteries as near as possible identical as to condition, age, and ampere-hour capacity, should be used. The batteries should be numbered for identification purposes. Odd numbers of treated batteries and even numbers for untreated batteries or vice versa. Ten batteries are to be treated with Battery AD–X2 and 10 batteries are to be left untreated and 1 battery to be withheld for comparison purposes.

4. All batteries should be opened for inspection. If the batteries are truly sulfated, the plates will be hard. The positive plates will at times be somewhat lighter in color than normal. However, the white discoloration, so ofttimes mentioned in battery parlance, need not be present to determine that a battery is sulfated. The separators should be checked to make sure that they are not dry, shrunken, or in an otherwise deteriorated condition.

5. The positive plates should be spot checked to determine the mechanical soundness as well as the amount of lead remaining in the positive grids. Batteries of the type under discussion will be found to have practically all their active material in both the positive and negative grid. Should there be more than one-fourth of an inch of mud in the bottom of any cell container, the battery is not suitable for this test.

To determine the soundness of the grid structure, place a nominal amount of pressure on the lower corner of the positive plate diagonally opposite from the ear connecting the plate to the bus bar. This pressure should be applied about 1 inch in from the edges of the plate by using the thumb and the first and second finger. At the same time, lightly twist the positive plate backward and forward to determine if there are any serious fractures in the grid structure. This should be done on 2 or 3 positive plates of each cell. Break one positive plate per cell in battery No. 21 for grid inspection comparison.

Crosswires in the grid of the positive plate in sulfated batteries with the diameter of less than $^{50}/_{1000}$ of an inch is insufficient to conduct enough current for charge and discharge of a positive plate. Negative plates in sulfated batteries will be found to be hard, with color ranging from dark slate gray to a very light gray. The two outside negative plates in a cell may show some shedding on initial charge in the treated batteries due to lack of support during transformation.

Where rubber separators are encountered, they may be used regardless of their dryness but, they should be slipped out from between the plates and turned end for end.

6. After determining that the elements of the batteries are sulfated by hardness of the plates and determining that the batteries are mechanically sound, they should be reassembled and filled to the proper level with electrolyte. For test purposes it is not necessary to replace the sealing compound. The electrolyte should not be allowed over one-fourth of an inch above the top of the plates where the sealing compound is not replaced as too high an electrolyte level leads to spillage and spewing from gassing and allows current to pass across the top of the cell covers during charging.

7. *Treating and charging batteries.*—Open voltage as well as hydrometer and temperature readings should be taken on all 20 batteries prior to placing on charge.

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[1] When batteries of the shelf-sulfated type are used, add only acceptable water to bring the electrolyte to its proper level and add only acceptable water throughout the test.

[2] When batteries of the dry-charged or moist-charged sulfated type are used, add acid of the specific gravity recommended by the manufacturer to fill the battery. Allow to stand for 24 hours before putting on charge. Recheck the fluid level and add sufficient acid of the same specific gravity to bring the electrolyte up to the proper level. Add acceptable water only for the remainder of the test.

(*a*) Do not first attempt to charge batteries to be treated and then treat, as prolonged charging on badly sulfated plates prior to treatment corrodes the positive grid. The 10 untreated batteries are the controls. For the purpose of this test which is a short-term test, disregard paragraphs 15 and 24 of form 90 other than those portions which are written into this test.

(*b*) Place batteries on charge at 5 amperes. Treat each cell of the 10 batteries which have been properly numbered for treatment, with 1 envelope of Battery AD–X2 in accordance with paragraph 32 of the enclosed form 90, immediately. Leave the other 10 batteries untreated. Place the 10 treated batteries and the 10 untreated batteries on separate charging currents of the same value.

(*c*) Use separate hydrometers and separate syringes for the treated and untreated batteries.

(*d*) Tabulate and compare the amount of water added to the treated and untreated batteries.

8. Charging and tabulation for the first 24 hours.—All batteries are to be charged at 5 amperes for the first 24 hours. Take voltage, hydrometer, and temperature readings at 30-minute intervals for the first 2 hours. (Temperatures should all be kept below 120° F. on all batteries at all times.) Then readings on voltage, hydrometer, and temperature should be taken at 2-hour intervals for the remainder of the first 8-hour period of charging. Then readings on voltage, hydrometer, and temperature may be omitted until the 23d hour of charge. Between the 23d and 24th hour, readings should be taken and recorded. At the end of the 24th hour of charge, the charging values should be stepped up to 1 ampere per positive plate. Thus, on a 15-plate battery the charging current would be 7 amperes. If any battery in one of the charging circuits goes above 120° F., the charging current of that circuit should be reduced and the temperature of the offending battery recorded by number. When the temperature of this battery has lowered sufficiently, return the charging current to its original value whether this be the 5-ampere rate or the 1-ampere per positive plate rate. The charging current should be maintained at the 1 ampere per positive plate rate during the 8 hours of the working day, taking 3 voltage, hydrometer, and temperature readings during the 8-hour working day, at the beginning of the day, 1 at midday and 1 at the end of the day. The charging amperage should be dropped to 5 amperes during the 16 hours in which there is no attendance at the charging line and increased to the 1 ampere per positive plate during the 8-hour working day, recording the voltage, temperature, and hydrometer readings during the working day as outlined above, until the batteries are fully charged. (Should the specific gravity of any battery go above 1,280 specific gravity with temperature corrections during the above outlined charging, acid should be drawn off and acceptable water added to lower the specific gravity to slightly below 1,280. A notation of this should be tabulated by battery number. The batteries will have been fully charged when the voltage has reached 2.5 volts per cell or better and the hydrometer reading has stopped increasing after three successive readings as outlined for readings during the working day.) Also, the batteries should be gassing freely but in no case should the batteries be considered fully charged until they have received not less than 80 hours at the 5-ampere rate and 40 hours at the 1 ampere per positive plate rate. This is somewhat better than 600 percent of the ampere-hour capacity of the batteries. Before taking batteries off charge, be sure that the electrolyte level is a minimum of one-fourth of an inch above the top of the plates, as the level of the electrolyte will drop depending on the amount of gas trapped in the cells, and the temperature of the electrolyte at the end of the charge. The batteries should then be taken off charge. Dry tops of batteries. The battery connectors should be disconnected and the batteries allowed to stand for 48 hours. At the end of 48 hours, voltage, hydrometer readings and temperature readings should be taken and electrolyte levels noted and included in the recording.

9. Five batteries treated with Battery AD–X2 and five untreated batteries should be opened for inspection. If truly sulfated batteries were used in the beginning, the following results will be noted:

Treated batteries.—The paste will be found to be soft and porous and the active material in both the positive and the negative plates will be found to be in firm contact with the grids. There will be little peroxidization of the grids in the positive plates. There will be no warping or buckling of the plates and little shedding. The overall appearance of these batteries will indicate many months of useful service.

Battery No. 21 may be used for comparison to establish the original condition of all batteries at this time.

Untreated batteries.—It will be noted that the positive grids are largely, if not entirely peroxided out in the positive plates and that the plates will disintegrate under pressure and twisting, as outlined in paragraph 5, page 1. The active material in the negative plates will be found to be pried loose from the grid which will cause it to be chunky and sandy (the plates may or may not be warped). Shedding of the active material from the plates will be considerably heavier than in the treated batteries. The condition of these batteries, if they were truly sulfated at the beginning, will show that they have little, if any, life expectancy, or they may be inert.

Five Battery AD–X2 batteries and five untreated batteries should be given the following individual discharge test:

Using a discharge unit, preferably but not necessarily a carbon pile, discharge each battery at 300 amperes as long as it will discharge 300 amperes—keeping track of the voltage drop and temperature at 1-minute intervals. When the battery will no longer hold a 300-ampere discharge, reduce the discharge rate to 200 amperes. Then record the voltage drop and temperature at 1-minute intervals as long as the battery will hold a 200-ampere discharge rate. When it will no longer hold a 200-ampere discharge rate, reduce the discharge rate to 100 amperes and take voltage drop and temperature at 1-minute intervals as long as it will hold the 100-ampere discharge rate (take care that both the treated and untreated batteries are held at the same ampere rate in the successive steps and in the same room or location so that the temperatures under which they are discharged will be approximately the same). When the batteries will no longer hold a 100-ampere discharge discontinue the test. Take hydrometer readings on both the treated and untreated batteries.

This is a suicide test and not a part of the instructions for use of Battery AD–X2. However, the 10 treated batteries which have been used in this test may be put into service and many months of satisfactory service may be expected from them under the most severe operating conditions.

Mr. RITCHIE: Insert: Letter from Dr. A. V. Astin, Acting Director of the Bureau of Standards, to Jess M. Ritchie, dated May 23, 1952. Quoting:

The Bureau will make no adjustment in specific gravity of the batteries by the removal of acid and addition of water during the course of the tests. This represents a minor deviation in procedure suggested by you in paragraph 8 of your test. I would like your concurrence in this deviation.

Again quoting from the same letter:

You will not be allowed to watch the Bureau's tests although you will be permitted to see the test setup prior to and at the end of the tests.

(The document above referred to is as follows:)

UNITED STATES DEPARTMENT OF COMMERCE,
NATIONAL BUREAU OF STANDARDS,
Washington 25, May 23, 1952.

Subject: Battery AD–X2.

Mr. JESS M. RITCHIE,
President, Pioneers, Incorporated,
2411 Grove Street, Oakland 12, California.

DEAR MR. RITCHIE: Reference is made to your letter of March 15, 1952, and to our telephone conversations concerning your product, Battery AD–X2. The Bureau is willing to conduct additional tests on your product following generally the procedure described in the so-called "Procedure for Testing Battery AD–X2 (Suicide Test)" of June 1, 1951, which you transmitted in your letter. Qualifications and conditions for this test will be as follows:

1. The Bureau has secured 21 shelf-sulfated storage batteries which will be turned over to you for mechanical inspection and repair according to the procedure outlined in paragraphs 1 to 5, inclusive, of your above test procedure. These batteries consist of 6 cells connected in series-parallel to provide 6 volts. The cells in each battery should be regrouped to give two 6-volt units, thus giving a total of 42 batteries of 6 volts each.

2. After you are satisfied that the batteries are mechanically sound you will return them to the Bureau filled to the proper level and sealed.

3. The Bureau will then mark the cells and treat half of them with Battery AD–X2. The cells selected for treatment will be chosen at random according to a procedure to be named by the Bureau's statistical experts and will be charged on 2 circuits, each circuit containing an equal number of treated and untreated cells. This represents a minor deviation in procedure suggested by you wherein odd numbered batteries are treated and even numbered batteries are untreated, or vice versa, and kept on separate circuits. The code to the treated cells will be known only to me until the tests are completed.

4. The Bureau will make no adjustment in specific gravity of the batteries by the removal of acid and addition of water during the course of the tests. This represents a minor deviation in procedure suggested by you in paragraph 8 of your test. I would like your concurence in this deviation.

5. You will not be allowed to watch the Bureau's tests although you will be permitted to see the test set-up prior to and at the end of the tests.

6. Various experts from the Bureau staff will be asked to inspect and rate the battery plates in accordance with the first part of paragraph 9 of your test. Experts from other government laboratories will also be invited for this inspection. In addition you and one or two others you may wish to include will be allowed to inspect and rate cells according to paragraph 9 of your test, but you will not be informed as to which cells were treated prior to making your ratings. According to the claims made in your test description there should be no difficulty in distinguishing between the treated and untreated cells. After the visual inspection we may conduct chemical tests from selected segments of the cell plates.

7. Presumably if your product does what you claim it will do, the cells treated with it will give a higher watt-hour capacity than the untreated cells. Since we will have no assurance that all the cells are of equal quality prior to starting the tests, the results will be subject to some statistical variation. Criteria for a statistically significant improvement of the battery cells due to the additive will be established by the Bureau's statistical experts.

8. If the tests do not establish definitely the usefulness of your product, I will expect you to concur that it has not been possible to demonstrate the value of your product. If the results show conclusively that your product is of value, then the Bureau's position on battery additives will have to be modified. Under no circumstances, however, shall you be permitted to use, either directly or by inference or implication, the fact of the Bureau's making these tests, the test data, or the test results for advertising, publicity or promotional purposes.

I would like your concurrence in the above test conditions. If you concur, we will turn the batteries over to you at once for inspection and repair and we will start the tests within one week after you return them to us.

Sincerely yours,

A. V. ASTIN, *Acting Director.*

Mr. RITCHIE. Remarks: The first quote was not a minor deviation but was a ruinous deviation.

Insert: Letter from Jess M. Ritchie to Acting Director of the Bureau of Standards, dated May 26, 1952. Quoting:

As we agreed at our meeting, should the specific gravity of the acid become higher than 1.280, it would then be necessary to draw off acid and add water.

(The document above referred to is as follows:)

MAY 26, 1952.

Subject: Battery AD–X2.

Dr. A. V. ASTIN,
Acting Director, National Bureau of Standards,
Department of Commerce, Washington 25, D. C.

DEAR DR. ASTIN: I wish to comment in detail on the conditions you set forth in your letter of May 23, 1952, on the above subject. The numbered paragraphs in this letter refer to the similarly numbered paragraphs in your letter.

1. Acceptable.
2. Acceptable.
3. As we discussed and agreed at our meeting on May 23, 1952, care will have to be taken by the Bureau to avoid contaminating (partially treat) the untreated batteries or cells. Contamination may be avoided by using separate filler bulbs, hydrometers, and thermometers as outlined in paragraph 7–c, page 2, "Procedure for Testing Battery AD–X2 (Suicide Test), June 1, 1951."

Since twice as many 6-volt batteries are involved in the present test than were originally specified in the June 1, 1951, test, this makes it possible, as we agreed, to treat 10 6-volt batteries and leave 10 6-volt batteries untreated. Since the 6-volt batteries will be in 12-volt cases, we ask that the treated and untreated batteries be in separate cases for this portion of the test to prevent heat transfer. That is: 5 cases will contain treated batteries and 5 different cases will contain the untreated batteries. In this manner, the Suicide Test can be carried out without any variation whatsoever as to one-half of the total batteries tested while the remainder will be tested with the variations you have suggested as modified by our mutual agreement.

Of course, you will be the only one who knows which of these batteries are treated and which are untreated. This will necessitate the use of four charging circuits since you want to treat by cells and at random the remaining 20 6-volt batteries and use separate charging currents for charging after treatment.

4. When the cells are treated at random, it will be necessary to discharge the cells individually to arrive at their capacity. The rate of discharge should be at somewhere between 50 and 100 amps per cell since the discharge will be at 2 volts instead of 6. As we agreed at our meeting, should the specific gravity of the acid become higher than 1280, it will then be necessary to draw off acid and to add water to prevent damage to the negative plates and the separators. Water should be added in accordance with paragraph 7–D, page 3, of the "Suicide Test."

5. While I appreciate your kindness in permitting me to inspect the test setup prior to, and at the end of the tests, I believe that it would not be contrary to accepted Bureau practice for either myself or my representative to observe the test while it is in progress. Of course, I understand that I would be present at the Bureau's convenience and would interfere in no way whatsoever with the conduct of the test. In the event that I am excluded from the tests, however, it is my understanding that Dr. Keith Laidler of Catholic University, Dr. Reginald Scott Dean of the Chicago Development Company, or some other qualified and mutually acceptable person will be allowed to view the test.

6. It is my understanding that it is your intention that no one other than yourself will know which batteries or cells are treated and which are untreated until the test has been completed and the results are disclosed. It is further my understanding, that any chemical tests you may make of the cell plates after the test is completed will not be considered by the Bureau to be a part of the test in any way.

Since the Bureau is conducting the test, it should be the Bureau's responsibility to inspect and rate the battery plates as you suggest. In my judgment, it would not be proper for the Bureau to either ask for or to accept ratings of the plates by experts from other Government laboratories although inspection, as such, by any responsible, interested person should be permitted.

7. We expect that the treated cells and batteries will take a charge more rapidly at lower temperature as described in paragraph 8, page 3, of the "Suicide Test." The difference in watt-hours will depend somewhat on the reaction of the untreated cells to the overcharge.

I have a detailed comment to make on the statistical analysis mentioned in the last sentence of your paragraph 7. This will be furnished in a separate letter.

8. Our experience has shown that mechanically sound sulphated batteries and cells treated with Battery AD–X2 will take a charge in less time and at lower temperatures than similar untreated units. Observed differences between the treated and untreated units similar to the differences described on page 3, paragraph 8, and page 4, paragraph 9, of the "Suicide Test" will demonstrate the value of Battery AD–X2 and the usefulness of the additive.

The Bureau has already made tests of Battery AD–X2 and has released its findings to the National Better Business Bureau, to Senators, and other prominent persons, and these findings have been made known to the public by articles in trade journals and otherwise. The Bureau's findings were adverse to the claim advanced by Pioneers, Inc., for Battery AD–X2, and consequently my personal reputation, as well as that of my company, has been badly damaged. Under such circumstances, test results substantially in conformity with our past experience as described in the "Suicide Test" should cause the Bureau promptly and publicly to exercise every reasonable effort to repair this injury. Letter Circular 504 should be withdrawn immediately and public announcement of the withdrawal and the reason therefor should be made at that time by the Bureau.

I fully realize that the Bureau is not a commercial testing laboratory and I do not expect to be able to use the Bureau's tests, the test data, or the test results for advertising, publicity, or promotional purposes. However, I would like to have a copy of the Bureau's complete test record of the "Suicide Test" it conducts together with copies of the daily worksheets. My purpose in requesting these data is to complete my files on the subject. None of these data will be used in any way contrary to your expressed wishes.

Very truly yours,

PIONEERS, INC.,
JESS M. RITCHIE, *President.*

Mr. RITCHIE. A letter from Jess M. Ritchie, to Acting Director of Bureau of Standards, dated June 19, 1952, asking the Acting Director to contact customers of Pioneers, Inc., by telephone, at the expense of the Pioneers, Inc., to investigate their experience with Battery AD–X2.

Insert: Letter dated June 23, 1952, from Jess M. Ritchie to Director of Bureau of Standards, repeating previous request and giving additional information on telephone numbers. This was done because there was a rumor that the Acting Director of the Bureau was consulting with battery manufacturers' representatives on the proposed test.

(The documents above referred to are as follows:)

JUNE 19, 1952.
Refer to File D.

Dr. A. V. ASTIN,
Director, National Bureau of Standards,
U. S. Department of Commerce, Washington 25, D. C.

DEAR DR. ASTIN: Mr. Wilson tells us that you are going to make some outside calls concerning Battery AD–X2. We respectfully request that in addition to the names of the Officers we furnished you the other day that you call the following at our expense.

Dr. Harold Weber, Professor of Chemistry, Massachusetts Institute of Technology. Home phone, 3–0972, Hyde Park, Mass. Office phone, M. I. T., Kirkland 7–6900, Ext. 574. Dr. Weber is leaving for Chicago on Monday, the 23d of this month, and it is our hope that you will call him today. Dr. Weber was for a number of years with the Willard Battery Company and has been experimenting with Battery AD–X2 for well over a year.

Mr. Wansley, General Manager of Oakland Better Business Bureau. Phone, Glencourt 2–3030, Oakland, California.

Mr. R. B. Lohry, Engineer in Charge, City of Oakland, Radio Division, is also a Chemist and Electrical Engineer. Phone, Templebar 2–3600, Ext. 333, Oakland, California.

Mr. Gordon Jaeger, Master Mechanic, Dinwiddie Construction Company. Phone, Twinoaks 3–4011, Oakland, California.

Mr. Richard Bohn, formerly Manager of National Bureau of Standards, San Francisco, California, presently Concrete Chemist same office. Phone, Sutter 1–8913, San Francisco, Calif. Mr. Bohn has worked with batteries a number of years ago.

Mr. F. A. Harrell, Prest-O-Lite Distributor, Arlington, Va. Phone, Jackson 8–4664. Mr. Harrell has been in the battery business since 1916.

All persons mentioned in this letter do not have any interest in Pioneers, Inc. We realize this procedure may not be policy with your Bureau but, we believe you will agree that it is very important to establish the truth concerning Battery AD–X2. We will leave cash with this letter to cover the above phone calls or they may be charged to Metropolitan 3935, Ext. 3–E, by the long distance operator.

Very truly yours,

JESS M. RITCHIE.

JUNE 23, 1952.

Dr. A. V. ASTIN,
Director, National Bureau of Standards,
U. S. Department of Commerce, Washington, D. C.

DEAR DR. ASTIN: The following is supplementary information to my letter of June 19, 1952, to you.

Dr. Harold Weber has informed us that he will be available by telephone at Hyde Park, Massachusetts: 3–0972 this afternoon at five o'clock p. m. If for any reason you do not contact him at that time, I will be glad to relocate him again.

Col. Kehke, whose telephone number I previously gave you, is on leave this week and may be reached at his home phone in Arlington, Virginia, Jefferson 2–0592. I talked to Col. Kehke and he said he would be pleased to have you call him.

Mr. Gordon Jaeger, Master Mechanic for Dinwiddie Construction Company of Oakland, California, is on vacation this week. However, he has informed us that he may be reached at his home if you wish to call him. His home telephone number is Lucerne 2–2651, Hayward, California.

You may wish to talk to Mr. Ray D. Smith, owner of Bay Equipment Company and one of our oldest accounts as well as one of the largest Equipment Concerns on the west coast. Mr. Smith may be reached at Landscape 5–2190, Richmond, California. If Mr. Smith is not available, Mr. Al Gavillet, Equipment Supt. for that Company, would be able to answer any of your questions.

We would be glad to furnish you with the telephone numbers of hundreds of satisfied users of Battery AD–X2 if you should care to use them.

Very truly yours,

JESS M. RITCHIE.

Mr. RITCHIE. Letter from Jess M. Ritchie to Director of Bureau, dated July 14, 1952, requesting copy of test that had been completed on June 11, 1952, supposedly the "suicide test."

(The document above referred to is as follows:)

JULY 14, 1952.

Dr. A. V. ASTIN,
Director, National Bureau of Standards.
U. S. Department of Commerce, Washington 25, D. C.

DEAR DR. ASTIN: You will recall at the various meetings with us in your office concerning the testing of our product, Battery AD–X2, I constantly and continuously insisted that the specific gravity of all the batteries to be tested should be kept at/or below 1,280 SPG. until a gassing voltage of 2.5 volts per cell was reached during charge. We quote from "Procedure for Testing Battery AD–X2—Suicide Test" dated June 1, 1951, page 3, item 8:

"Should the specific gravity of any battery go above 1,280 spg. with temperature corrections during the above outlined charging, acid should be drawn off and acceptable water added to lower the spg. to slightly below 1,280. A notation of this should be tabulated by battery number. The batteries will have been fully charged when the voltage has reached 2.5 volts per cell or better and the hydrometer reading has stopped increasing after three successive readings as outlined for readings during the working day."

In a letter dated May 23, 1952, page 2, item 4, Astin to Ritchie, we quote:

"The Bureau will make no adjustment in specific gravity of the batteries by the removal of acid and addition of water during the course of the tests. This represents a minor deviation in procedure suggested by you in paragraph 8 of your test. I would like your concurrence to this deviation."

You and I discussed this point further between May 23 and May 26, 1952, at which times I explained to you that lead sulfate was little, if at all, soluble in acid of a density of 1,280 spg. or over unless the cell voltage had reached 2.5 volts, even in the presence of Battery AD–X2. I also said, "I did not believe the batteries could be charged unless the spg. was lowered when it went higher than 1,280 spg. in the batteries as I had never seen nor heard of this being done unless the batteries reached a gassing voltage of 2.5 volts per cell prior to or shortly after the hydrometer reached 1,280 spg."

In a letter dated May 26, 1952, from Ritchie to Astin, page 2, item 4, we again quote:

"As we agreed at our meeting, should the specific gravity of the acid become higher than 1.280, it will then be necessary to draw off acid and to add water to

prevent damage to the negative plates and separators. Water should be added in accordance with paragraph 7–D, page 3, of the Suicide Test."

As you know, we have never had a reply to this letter. Therefore, I was somewhat surprised when the same point came up for discussion in your office on June 2, 1952.

We quote from our chemist's report of that meeting: "The charging and discharging procedure was outlined in a letter from Mr. Ritchie to Dr. Astin and amended in conference with Dr. Craig, Mr. Snyder, and Dr. Astin on June 2, 1952. Several changes were made in Mr. Ritchie's procedure. The Bureau said that it did not wish to cut acid in the batteries. Mr. Ritchie protested this but had to compromise on an agreement to cut the gravity ten points on all cells in a line if a percentage of the cells went over 1.325 acid."

You will remember that Mr. C. L. Snyder was very insistent that the high acid would not make any difference in the batteries taking a charge. I said at that time that I did not see how the batteries could possibly take a charge if the acid went to above 1.280 spg. before the voltage reached 2.5 volts per cell, unless the acid was reduced by drawing off acid and then adding water to keep the acid concentration at/or below 1.280 spg. until the gassing voltage of 2.5 volts per cell had been reached. Mr. Snyder mentioned some aircraft batteries that he had worked with which used a finished gravity of 1.350 spg. Investigation discloses that these batteries are of very short life and that if they are sulfated to the point that when they are put on charge, the acid will reach a specific gravity of above 1.280 before a gassing voltage of 2.5 is reached, or shortly thereafter. Then, the batteries are no longer considered fit for service.

Also, you will recall during our discussion in your office on June 2, 1952, I told you that based on information I had obtained in charging the three (3) batteries which you had allowed me to take out of the test group, which had been excluded from the test due to mechanical weakness, I was sure that the acid would go above 1.280 before a gassing voltage of 2.5 volts per cell was reached and that the only thing which the test could show would be that Battery AD–X2 would cause the treated batteries to charge more rapidly at the beginning of charge (See letter dated May 26, 1952, page 2, item 7, Ritchie to Astin):

"We expect that the treated cells and batteries will take a charge more rapidly at lower temperature as described in paragraph 8, page 3, of the 'Suicide Test.' The difference in watt-hours will depend somewhat on the reaction of the untreated cells to overcharge."

This would be indicated by a more rapid increase in the hydrometer readings than could be accounted for by the slight increase in the hydrometer reading which is caused by the Battery AD–X2 material. I also thought we would possibly have a slightly lowered temperature in the first 24 to 48 hours of charge in the treated batteries.

Since our discussion, I have talked to scientists and practical battery men, and they will bear me out—that at higher acid concentrations the solubility of sulfation decreases as a result of changes in the equilibrium between the sulfate and the bisulfate ions of the acid solution increasing the resistance to a point that the gassing voltage of 2.5 volts (allowing for temperature) cannot be reached in a sulfated battery with 1.280 spg. acid or over. Thus, making it impossible to bring a sulfated battery to full charge even in the presence of Battery AD–X2.

I find it difficult to understand why Mr. C. L. Snyder and Dr. D. N. Craig, of your staff, were not familiar with these facts which are well known to every battery man and scientist I have contacted.

We have been patiently waiting for the release to us of the test results which was completed by your Bureau on June 10, 1952. You promised us sufficient data on these test results on Friday, June 13, for evaluation by our scientists. Then, on June 13, you promised that we could have that material on June 17. On June 17 you said we could have the material on the 20th of June. June 20th came, and you said it would be June 24th before it was available to us. On June 24th you said it would be the 27th. On June 27th you made another promise—we could have the material on July 7th. We have had no promise nor any word from you since July 7th.

As you know, Dr. Astin, my wife and I have been in Washington since April 4th. We have cooperated with your Bureau in every way possible in an attempt to reach the truth of this situation. Our business has, and is, suffering tremendously due to the arbitrary position taken by your Bureau on our product, Battery AD–X2. Now, don't you think in all fairness that we are entitled and that it is about time we have the results of the test?

Very truly yours,

JESS M. RITCHIE.

Mr. RITCHIE. Remarks: We had been waiting in Washington for a copy of this test report. The Senate Select Committee on Small Business received copies of this report and made them available to me—made available to me a copy of Test on a Battery Additive, on July 15, 1952.

No voltages were given in this test; no water losses were given; the specific gravity of the batteries showed an average of 1.3079 specific gravity for treated batteries, and 1.3051 for untreated batteries.

This high acid condition, above 1.280 specific gravity, which had been specifically specified and discussed, and which I protested, alone ruined this test.

However, on page 5 of the test it showed nine other modifications of our original test procedure. Hydrometer readings were taken 2 hours apart and treated as though they were taken simultaneously.

I had inspected the batteries prior to starting the test, and while they were not as badly sulfated as they could have been, I had three of the batteries tested out of the group which were rejected because of mechanical condition.

Three of these batteries showed higher hydrometer readings than could be accounted for on the basis of the additive added. They showed higher voltages, quicker lower temperatures and less water losses in the treated cells as compared with the untreated cells.

Criticism of the July 11, 1952, test, which later become known as the September 5, 1952, test, by Guy F. Wetzel, dated July 25, 1952, who is editor of the Battery Man magazine, in which he points out that the high acid in the batteries was ruinous to the test. He knows more about lead-acid storage batteries than any other man alive today.

(The document referred to is as follows:)

GUY F. WETZEL

MECHANICAL ENGINEER

1010 WEST CRESCENT AVENUE,
Park Ridge, Ill., July 25, 1952.

Mr. JESS M. RITCHIE
President, Pioneers, Inc.,
2511 Grove Street, Oakland 12, Calif.

DEAR MR. RITCHIE: In response to your request, I have carefully gone over the report of the National Bureau of Standards on their test of A Battery Additive which I understand refers to your product, Battery AD–X2.

The first thing that occurs to me is to wonder why heavy duty batteries, which no doubt have heavier grids and thicker plates, than the usual automobile battery, were used for making the test, since the thinner and lighter plates would show up more effectively the effects of oxidation of the grids, warping from sulphation, and shedding of active material.

Another point which could have considerable significance is the total omission of any voltage values. On page 2, paragraph 6, it states (quote) "The data taken during the tests (temperature, specific gravity, *voltage*, amperage, time, etc.) relevant to the effect of the additive on batteries, are presented in Section IV."

While voltage was mentioned as one of the important factors in the test to consider, it fails to show up in any of the data presented. In my own experience in working with batteries, I continually use a sensitive voltmeter to check charging and discharging results and consider this a serious oversight (or neglect) in obtaining data that will accurately indicate the result of using Battery AD–X2.

On page 10, the note at the bottom of the page says, "In no instance was there any *warping*. Consequently all batteries were '———' in this respect, and this characteristic has been omitted from further consideration in this analysis."

This would seem to differentiate the test from actual field experience, because warping of the plates and distortion of the battery case is a common occurance when severe sulphation takes place.

Considering the difference between the heavy-duty batteries used in the test and the light, thin plates used in passenger automobiles, I would consider that the differences between the treated and untreated plates shown up in the temperature readings and the watt-hour readings as doubly significant.

I notice in analyzing the "Average Specific Gravity of Trays for Each Charging Period" that for the treated batteries, the gravities for periods 5, 6, 7, 8, 9, they run well over the 1.280 that is considered as fully charged for passenger car and truck batteries.

As you well know, at the higher acid concentrations the solubility of sulphation decreases because of changes in the equilibrium between the sulphate and bisulphate ions of the acid solution. This increases the resistance to a point where the gassing voltage of 2.5 cannot be reached in a sulphated battery with higher than 1.280 gravity acid. Therefore the effectiveness of Battery AD–X2 will be minimized in trying to bring the sulphated battery to full charge.

An important step in the tests which it seems to me should have been taken and which would have been quite significant, would have been to take some of the batteries, and run discharge tests at various times or at earlier charging periods, so that the effect of the additive could have been apparent. As it was, waiting for the end of the long charging times, allowed for the catching up of the sulphated batteries, and this plus the high acid gravities permitted, decreased the showing that could have been made by the additive.

The fact that the sulphated batteries used in the tests took a charge with apparently little difficulty even though untreated, leads me to wonder if possibly the type of sulphation on these batteries was not different from that experienced in the field, since I have been unable to make sulphated batteries take a charge after 72 hours or more of charging, yet when Battery AD–X2 was added they would take a charge.

A statement on page 6 of the report brings up a question as the comparative value of the various readings. Quote: "About 2 hours were required to take and record a round of readings."

The data observed in the test is treated as if each value was simultaneously obtained, yet it took about 2 hours to get around to all the batteries. This would seem to indicate that the readings actually are not of too great value as noticeable and possibly important changes could take place in the two-hour period.

Summing up the various points mentioned, it, frankly, looks to me as if the report is that of persons referred to in the old saying: "A person convinced against his will, is of the same opinion still."

The statement on page 2: "The results of the above investigation, presented more fully in subsequent sections of this report, indicate that the battery additive tested ***has no beneficial effect*** on the properties or performances of batteries" is arbitrary and not in accordance with the data presented, and is definitely at variance with the experiences of the many enthusiastic users of Battery AD–X2 who have cut battery costs and extended battery life through its use.

I think you woud be justified in demanding another test, taking into account the various factors that make the test just completed of questionable value, this should include voltages as they are a very important factor, time factors not given in this test, more discharge tests, and control of gravities to keep below 1.280. spg at least until a gasing voltage of 2.5 per cell is reached—this is most important. Water losses should also be recorded.

Yours truly,

/s/ GUY F. WETZEL,
Member, Society Auto. Eng'rs.
Editor, Super Service Section
Battery Man Magazine.

Mr. RITCHIE. Letter dated August 5, 1952, from Dr. Keith J. Laidler to Jess M. Ritchie stating that if Dr. Laidler persisted in his attitude that Battery AD–X2 was beneficial to lead-acid storage batteries the Director of the Bureau of Standards would take it up with Dr. Laidler's superiors at Catholic University.

(The document referred to is as follows:)

2702 ALLISON STREET, MOUNT RAINIER, MD.,
August 5, 1952.

Mr. JESS M. RITCHIE,
President, Pioneers, Inc.,
2411 Grove Street, Oakland 12, Calif.

DEAR MR. RITCHIE: In this letter I am summarizing, at your request, the conversation I had last Tuesday (July 29th) with Dr. Astin at the Bureau of Standards.

Mr. O'Connor was present during the first part of the meeting. Essentially what I did was to point out and present to Dr. Astin the arguments that I had brought forward in my letter to you of July 21, 1952. Much of the discussion concerned the temperature results, and Dr. Astin rather grudgingly admitted (as had Dr. Eisenhart the previous week) that perhaps the treated cells were significantly lower in temperature. However, Dr. Astin insisted that this did not necessarily imply improvement, and tried to argue that it might seem that the untreated cells were charging more rapidly. I pointed out the implausibility of this as best I could, but had no success in convincing him—he said I was "clutching at straws" in bringing up such a point.

The rest of the discussion followed similar lines. Whenever I argued in favor of a significant effect, he argued that it did not mean anything in favor of better performance. He insisted several times that he thought that the only significant parts of the test were the visual inspection and the discharge measurements. When I said that the results showed evidence of a more rapid charging of the treated cells, he said that was outside the scope of the test; both Mr. O'Connor and I denied that. (See paragraph 8, May 26th, 1952, letter from Ritchie to Astin.)

After one and a half hours of this fruitless discussion, Mr. O'Connor had to leave, and Dr. Astin asked me to stay behind and discuss my report on their Circular 504. Dr. Astin's manner then changed very considerably, and the rest of the meeting consisted of his taking me to task for getting involved in this matter. He said that the evidence was so strongly in favor of AD–X2 being worthless that anyone who thought otherwise simply was not exercising sound scientific judgment. He said that he had been particularly surprised at my taking this view of the product, in view of my scientific training and experience. For some years he had been following my research career with interest and had a high opinion of me, but now he could not understand what had happened to me. He said he felt I had "betrayed my scientific training" by supporting AD–X2.

Dr. Astin also said that Dr. Rice, my superior at the University, was a good friend of his and that he was going to "take the matter up with him."

I did not say much during this discussion, as I did not feel any need to defend my position, since I had already expressed it clearly in writing. On my part, of course, I was very much surprised at Dr. Astin's change of attitude after Mr. O'Connor left concerning my position on the subject. I was also very much surprised at Dr. Astin, particularly his thinking that Circular 504 was an adequate document; from his remarks it is evident that he thinks it is an excellent piece of work. He was particularly incensed at my saying the controls were not adequate. In fact, for most of the tests only one battery was used, with two cells treated with each additive; apparently the one untreated cell gives adequate statistical control according to Bureau methods. It really is astonishing what these people will try to foist on to us.

My main conclusion of this discussion is that if there is to be another test it is *essential* for us to have a complete understanding *beforehand* as to what will be considered significant.

Sincerely yours,

KEITH J. LAIDLER.

Mr. RITCHIE. Insert: Letter from Shepherd Tractor & Equipment Co. to Terry & Co., our distributors in Los Angeles, dated August 25, 1952. Quoting:

The Better Business Bureau and the National Bureau of Standards have joined the battery manufacturers in turning "thumbs down" on these products.

He is speaking of Battery AD–X2.

(The document referred to is as follows:)

SHEPHERD TRACTOR & EQUIPMENT CO.,
Los Angeles, August 25, 1952.

TERRY & COMPANY,
2533 E. Slauson Avenue, Huntington Park, Calif.
(Attention: Mr. A. J. Terry.)

DEAR SIR: I have discussed with you and your representatives, on various occasions, the use of AD–2X in batteries, which according to information I received from you is instrumental in improving battery life and reducing sulfation.

The following is an excerpt from a bulletin No. FSB 192–S, June 1952, which was published by the John Deere Plow Co., which manufactures the John Deere Tractor & Engines, for which we are distributors, the majority of which are equipped with battery systems.

"In the past few months you may have received advertisements for battery 'rejuvenators', claiming that use of these 'tonics' or 'dopes' will materially increase battery life and improve performance. These concoctions may assume the form of either an additive or a complete new supply of electrolyte to replace the original.

"Tests by leading chemical and electrical concerns have proven that no such preparation now in existence will aid battery performance in any way. In fact, most of these chemicals will actually harm the battery and shorten its life.

"The Better Business Bureau and the U. S. Bureau of Standards have joined the battery manufacturers in turning 'thumbs down' on these products."

If the above information is correct, and at the present time I have no reason to doubt their statement, the program of the use of AD–2X in our batteries which I have discussed with you, would be merely a case of money wasted.

I would be very much interested in the reason for the John Deere Plow Co. thinking this, if your product is as has been reported by you. Any information which you may have regarding John Deere's acceptance of AD–2X would be of interest to me.

Very truly yours,

SHEPHERD TRACTOR AND EQUIPMENT CO.,
L. A. SOMERS, *General Service Manager.*

Mr. RITCHIE. Insert: September 5, 1952, a mathematical correction sheet by the National Bureau of Standards setting forth somewhat over 30 corrections in their July 11, 1952, tests of Battery AD–X2.

(The document referred to is as follows:)

UNITED STATES DEPARTMENT OF COMMERCE, NATIONAL BUREAU OF STANDARDS

CORRECTIONS TO "TEST OF A BATTERY ADDITIVE"

In routine checking of the computations in the report "Test of a Battery Additive by the National Bureau of Standards," dated July 11, 1952, a few minor typographical and computational errors were discovered. These errors and the changes growing from them are listed below. Neither the significance of the data as originally presented nor the conclusions of the report are affected.

Page 17:
Line 18 now reads, "5 out of 9"; change to "4 out of 9."
Line 20 now reads, "4"; change to "5."
Line 22 now reads, "5th"; change to "7th."
Line 23 now reads, "—1.08"; change to "—.80."
Line 24 now reads, "2.35"; change to "3.15."
Line 25 now reads, "1.80"; change to "1.30."
Line 28 now reads, "(—2.3, 0.2)"; change to "(—2.1, 0.5)."
Line 30 now reads, "—2.3 and +0.2"; change to "—2.1 and +0.5."
Line 31 now reads, "(i. e., —2.3)"; changed to "(i. e., —2.1)."
Page 18:
(1) Tray 1—charging period 4; now reads "46.90"; change to "45.90."
(2) Tray 1—charging period 5; now reads "37.95"; change to "37.45."
(3) Tray 1—charging period 9; now reads "45.00"; change to "45.10."
(4) Average treated—charging period 9; now reads "44.10"; change to "44.92."
(5) Average untreated—charging period 5; now reads "39.73"; change to "39.37."

(6) Difference in averages—charging period 5; now reads "—1.08"; change to "—.72."

(7) Difference in averages—charging period 9; now reads "—.10"; change to ".72."

Item (1) is incorrectly plotted on figure 1.

Items (6) and (7) are incorrectly plotted on figure 2.

Page 21: 4th charging period:

Column now reads	1	3	9	6	10	4	2	7	5	8	29	26	.4
Change to	3	2	9	6	10	4	1	7	5	8	30	25	.3

Page 23:

Tray 4—charging period 2; now reads "1.2145"; change to "1.2240."

Tray 4—charging period 7; now reads "1.2960"; change to "1.2910."

Tray 10—charging period 7; now reads "1.3070"; change to "1.3020."

Tray 3—charging period 3; now reads "1.2295"; change to "1.2390."

Tray 5—charging period 2; now reads "1.2220"; change to "1.2320."

Difference in averages—charging period 8; now reads ".0062"; change to ".0052."

NATIONAL BUREAU OF STANDARDS,
Washington 25, D. C., September 5, 1952.

Mr. RITCHIE. Insert: On September 29, 1952, in the morning, a meeting was held concerning Battery AD–X2 in the Assistant Solicitor's office at the Post Office Department. I did not attend this meeting.

On the afternoon of the same day another meeting was held at the Bureau of Standards on the subject of Battery AD–X2. I attended this meeting.

It was my understanding at this meeting that the Director of the Bureau would like to see tests run on Battery AD–X2 somewhere other than at the Bureau of Standards. It was my further understanding that if tests could be run at MIT, the Bureau's personnel could participate. When arrangements were made and the time set to begin the tests, the Bureau refused to participate.

Concerning the arrangements to participate: In the United States Department of Commerce, National Bureau of Standards, February 10, 1953, Statement on a Battery Additive, which, incidentally, was released to a national publication, condemning AD–X2 by name, we find the following statement:

Approximately 2 weeks after the September 29, 1952, conference, Mr. O'Connor informed the Bureau that MIT was planning to carry out a more extensive series of tests to check further Dr. Weber's preliminary observations. The Bureau was invited to participate in these. This invitation was declined primarily because it was believed that any findings unfavorable to the material would have been more acceptable to proponents of the additive if the tests were conducted without the Bureau of Standards' participation.

In this same report the Bureau of Standards condemned the work by MIT on the basis that these tests were not run under normal battery operations. I know of no test run at the National Bureau of Standards under normal battery operations. In fact, the use of lead-acid batteries varies to such an extent that, quite frankly, I do not know what the normal operation of a battery is.

Insert: September 17, 1952, a letter from Director of Bureau of Standards, Dr. A. V. Astin, to Senator Herbert H. Lehman. Quoting:

I believe that the Bureau has been objective and thorough in this matter and that if the additive had any useful properties it would have been possible to demonstrate them in these tests. The tests may be considered conclusive in that no useful properties of the additive were found, using a procedure which the manufacturer claimed would reveal them.

You will recall the 10 changes on page 5 of the test report.

(The document referred to is as follows:)

U. S. DEPARTMENT OF COMMERCE,
NATIONAL BUREAU OF STANDARDS,
September 17, 1952.

The Honorable HERBERT H. LEHMAN,
United States Senate, Washington, D. C.

MY DEAR SENATOR LEHMAN: In my letter of May 26, 1952, on the subject of Battery Additive AD–X2, I agreed to send you the results of the new tests of this product. Copies of our report are enclosed.

The results of these tests show the battery additive to be of no value, confirming the earlier findings of the Bureau as reported in our Circular 504 (copies enclosed).

I believe that the Bureau has been objective and thorough in this matter and that if the additive had any useful properties it would have been possible to demonstrate them in these tests. The tests may be considered conclusive in that no useful properties of the additive were found, using a procedure which the manufacturer claimed would reveal them.

Very truly yours,

A. V. ASTIN, *Director.*

Mr. RITCHIE. Test report of starting, cranking, discharge of Battery AD–X2 treated and untreated batteries; United States Testing Co., Inc., September 30, 1952; Test No. E–3576–2.

Remarks: AD–X2-treated batteries showed larger capacity and quicker recovery on charge.

(The document referred to is as follows:)

UNITED STATES TESTING CO., INC.

Hoboken, N. J.

PROGRESS REPORT NO. 1

Test No. E–3576–2—September 30, 1952
Pioneers, Inc., 2411 Grove Street, Oakland 12, Calif.
Materials tested: Battery AD–X2
Nature of tests: Starter cranking discharge of AD–X2 treated and untreated batteries
By A. S. Mindes, Engineering Department, United States Testing Co., Inc.

GENERAL

On October 5 to 8, 1951, we inspected the facilities of the Dev-T-Co., AD–X2 Station No. 550, 4925 Reistertown Road, Baltimore, Md. Tests were made on the use of Battery AD–X2 as a battery additive to eliminate sulfation in mechanically sound sulfated lead-acid batteries. Comparison tests were made for the cranking ability of batteries processed with "Battery AD–X2," used and unused sulfated batteries versus untreated new-stock batteries and shelf-sulfated batteries.

PROCEDURE

We observed through the following tests; the seeming elimination of sulfation in shelf-sulfated and used discarded mechanically sound sulfated batteries by treatment with Battery AD–X2.

The batteries used in the test are as follows:

Two new 100-ampere-hour batteries Nos. 1 and 2 were purchased from separate sources—Stern Amoco Service, and Astrin & Son, of Baltimore, Md. These batteries were given a tapering charge of 4 amperes until they were fully charged, and used as comparison checks in dead motor, started cranking timed discharge tests.

A group of shelf-sulfated batteries were purchased from the Motor Sales Co., Inc., and Martin Motors, Inc., of Baltimore. These batteries were divided into 2 similar groups of 9 each, keeping an equal division in each group of similar open-voltage readings. One group was given Battery AD–X2 treatment, the other left untreated. The 2 groups were placed on a tapered charge, 6 amperes—3.5 amperes for 20 hours. Batteries were numbered 3–20.

Three heavily sulfated (of questionable mechanical soundness) 15-plate (100-ampere-hour) cells were chosen for processing from the incoming junked battery pile. These cells were reinsulated with Port Orford cedar separators and installed in a hard-rubber case with 1.150 specific gravity acid added. Battery AD–X2 was added and the battery placed on a tapered 6- to 4-ampere charge for 17 hours. The battery was designated No. 21, experimental.

One AD–X2 processed battery, No. 22, from discarded batteries. This battery was processed 3 months previous to this test and was used as a demonstrator in a 1941 Chevrolet. The battery was reopened and examined to verify that it was a 100-ampere-hour 15-plate-cell battery and a reprocessed one.

The tests were divided into three groups:

(1) Batteries Nos. 1 and 22 discharged cranking a 1941 Chevrolet, with headlights on; repeat total discharge after 3 minutes recuperation; repeat cranking discharge after driving car through heavy traffic for 10 miles; and repeat engine start after 10-second recuperation.

(2) Batteries Nos. 2 and 22 discharged cranking a 1948 Chevrolet truck, lights on; first recuperation time taken at 7 minutes, no traffic run, and final engine start after 10 seconds.

(3) Batteries Nos. 15 and 17 chosen at random from the two groups of shelf-sulfated batteries, discharged cranking a 1951 Packard model 200, lights on, first recuperation time 3 minutes, and engine-start test at 10 seconds rest.

Experimental battery No. 21 was treated with AD–X2 and charged as previously stated. Although this charge was not complete, the battery was given discharge tests to check the effects of the additive.

The ability for the battery to take a recharge, using the generator of a car, was tried by taking the automobile out on the road for 45 minutes. The generator output maximum was 35 amperes. The load on the line was 18 amperes, leaving 17 amperes for the battery.

Cranking tests were repeated, then the battery was opened to check for buckling and lead condition.

Cranking discharge tests—Cranking time

Test No.	Battery No.	AD-X2-treated	Specific gravity		Initial time	Initial cranking efficiency	After following periods						Start after 10 seconds	Final temperature (degrees Fahrenheit)
			Initial	Final			3 minutes	Cranking efficiency	10 miles	Cranking efficiency	7 minutes	Cranking efficiency		
						Percent		*Percent*		*Percent*		*Percent*		
1	1	No			17 minutes 30 seconds.	100	2 minutes 15 seconds.	100	6 minutes 48 seconds.	100			Yes	
	22	Yes			22 minutes 45 seconds.	130	1 minute 22 seconds.	65	10 minutes 43 seconds.	157			Yes	
2	2	No	1.280	1.160	12 minutes 53 seconds.	100					1 minute 56 seconds.	100	Yes	106
			1.280	1.160										
			1.280	1.160										
	22	Yes	1.280	1.180	16 minutes 12 seconds.	126					2 minutes 20 seconds.	120	Yes	104
			1.280	1.180										
			1.280	1.180									Yes	91
3	17	No	1.265	1.185	3 minutes 22 seconds.	100	55 seconds	100						
			1.260	1.190									Yes	88
	15	Yes	1.265	1.185	5 minutes 28 seconds.	162	1 minute 55 seconds.	209						
			1.265	1.200										
			1.250	1.180										
			1.260	1.190										

NOTE.—(1) For percent cranking efficiencies, the untreated batteries were given an arbitrary base of 100 percent, the treated batteries were compared to this base.
(2) In lieu of a resistive load, the cranking starters and engines of various automobiles (ignition disconnected) were used during these tests.

DATA

Test No. 1

Cranking performed on a 1941 Chevrolet sedan used as a demonstrator. Lights were on during cranking and traffic runs.

Battery No. 1.—New, untreated 100 amp/hr., 15 plates/cell manufactured August 1951:

Cranking time: 17 minutes, 20 seconds.
After 3 minutes rest: 2 minutes, 15 seconds.
After 10-mile traffic run, for charge: 6 minutes, 48 seconds.
10-second rest: engine started.

Battery No. 22.—AD–X2 treated, 100 amp/hr., 15 plates/cell battery used as demonstrator for 3 months:

Cranking time: 22 minutes, 45 seconds.
After 3 minutes rest: 1 minute, 22 seconds.
After 10-mile traffic run, for charge: 10 minutes, 43 seconds.
10-second rest: engine started.

Test No. 2

Cranking performed on 1948 Chevrolet delivery truck. Lights on during cranking runs.

Battery No. 22.—AD–X2 treated 100 amp/hr., 15 plate/cell recharge 5–4 amps tapered for 23 hours:

Cranking time: 16 minutes, 12 seconds.
After 7-minute rest: 2 minutes, 20 seconds.
10-second rest: started engine.
Final temperature: 104° F.
Initial specific gravity: 1.280, 1.280, 1.280.
Final specific gravity: 1.180, 1.180, 1.180.
300 amps/5 sec. discharge, voltage reading: 3.9 volts.
Open voltage reading: 6 volts.

Battery No. 2.—New, untreated 100 amp/hr., 15 plate/cell battery manufactured August 1951:

Cranking time: 12 minutes, 53 seconds.
After 7-minute rest: 1 minute, 56 seconds.
10-second rest: started engine.
Final temperature: 106° F.
Initial specific gravity: 1.280, 1.280, 1.280.
Final specific gravity: 1.160, 1.160, 1.160.
300 amp/5 sec. discharge voltage reading: 3.9 volts.
Open voltage reading: 6 volts.

Test No. 3

Cranking performed on 1951 Packard model 200, lights on during cranking test.

Battery No. 15.—AD–X2 treated, 90 amp/hr., 13 plate/cell tapered charge 6–3.5 amps for 20 hours:

Cranking time: 5 minutes, 28 seconds.
After 3-minute rest: 1 minute, 55 seconds.
10-second rest: engine started.
Final temperature: 88° F.
Initial specific gravity: 1.265, 1.250, 1.260.
Final specific gravity: 1.200, 1.180, 1.190.
Initial open-cell voltage: 1.2, 0.9, 1.2.
300 amp/5 second discharge after fresh charge: 4.6 volts.
300 amp/5 second discharge after final cranking: 3.9 volts.
Open voltage: 6.0 volts after each discharge.
Initial open voltage: 6.3 volts after charge.

Battery No. 17.—Untreated, 90 amp/hr., 13 plates/cell tapered charge, 6–3.5 amps for 20 hours:

Cranking time: 3 minutes, 22 seconds.
After 3-minute rest: 52 seconds.
10-second rest: engine started.
Final temperature: 91° F.
Initial specific gravity: 1.265, 1.260, 1.265.
Final specific gravity: 1.185, 1.190, 1.185.
Initial open-cell voltage: 1.3, 1.2, 1.1.
300 amp/5 second discharge after fresh charge: 4.3 volts.

300 amp/5 second discharge after final cranking: 3.0 volts.
Open voltage after each discharge: 6.0 volts.
Initial no-load open voltage after charge: 6.3 volts.

Experimental battery No. 21.—Cranking performed on a 1951 Packard model 200 with lights on at all times during cranking. Reprocessed from junked batteries, cells of questionable mechanical soundness treated with Battery AD–X2, and charged 6–4 amps for 17 hours (100 amp./hr. 15 plates/cell):

Initial open voltage after charge: 6.3 volts.
300 amps/5 sec. discharge: 4.7 volts.
Open voltage after discharge: 6.0 volts.
Specific gravity: 1.265, 1.210, 1.225. Because this battery had not received a full charge, the acid was not adjusted.
Cranking: 6 minutes 45 seconds.
After 3 minutes rest: 1 minute 47 seconds.
10 seconds rest: Started engine.
Final temperature: 88° F.
Final specific gravity: 1.200, 1.150, 1.175.
300 amp/5 sec. discharge 3.9 volts.
Open circuit voltage 6.0 volts.

Forty-five (45) minutes drive with vehicle, with radio and lights on, generator output 35 amps, total load 18 amps:

Cranking time; 5 minutes 10 seconds.
After 3 minutes rest: 1 minute 6 seconds.
10 seconds rest: Started engine.
End temperature (battery under hood at all times): 98° F.
Final specific gravity: 1.200, 1.150, 1.175.
300 amp/5 sec. discharge 3.5 volts.
Open circuit voltage: 6.0 volts.

TENTATIVE CONCLUSIONS BASED ON SHORT-TIME TEST

During this test it was observed that the addition of Battery AD–X2 to a sulfated mechanically sound battery permitted a higher charging/discharging efficiency. Battery AD–X2 treated batteries maintained a slightly lower charging temperature and supplied a higher discharge in amp/hrs. than equivalent size new batteries.

An internal examination of experimental battery No. 21 indicated that the lead plates were returning to their originally new condition.

Mr. RITCHIE. Insert: Letter from Tram Car Amusement Co., dated November 14, 1952, to Quaker Battery Service Co., our distributor of Battery AD–X2. Quoting:

Since treatment with Battery AD–X2, the overall operating time, or capacity of these batteries has been extended approximately 25 percent. Furthermore, the time necessary for recharging has been cut from 10 to approximately 8 hours.

Remark: These are large industrial-type batteries and were partially sulfated, I am told by my distributor. That is reported to me by my distributor.

(The letter referred to is as follows:)

TRAM CAR AMUSEMENT CO.,
Wildwood, N. J., November 14, 1952.

QUAKER BATTERY SERVICE CO.,
5512 Arch Street, Philadelphia, Pa.

(Attention: Mr. R. D. Parsons.)

DEAR MR. PARSONS: We operate four (4) small locomotives at Casino Park, Wildwood, N. J., which pull trailers transporting people on the Boardwalk at the Amusement Park. Each of these locomotives are equipped with a fifteen-cell, thirty-volt lead-acid battery, with a rated capacity of 495 ampere-hours. These batteries are normally used only during the Summer months or approximately three (3) months each year.

After thoroughly investigating your service, we treated these batteries with battery AD–X2 in the Spring of 1952, before they were put into service. The batteries were four (4) years old at the time of treatment, and due to their age were not operating at their full rated capacity.

Since treatment with battery AD–X2, the overall operating time, or capacity of these batteries has been extended approximately twenty-five (25%) percent. Furthermore, the time necessary for recharging has been cut from ten to approximately eight hours.

The results were so gratifying, at the end of the Summer Season in Wildwood, the equipment with the treated batteries was sent to the Eastern States Exposition, at Springfield, Mass. They were also sent to the N. J. State Fair, at Trenton, N. J., there to transport people around the Fair grounds. The batteries performed equally as well in both these locations. At the present time, it appears to the writer as tho' these treated batteries will go thru' the next Summer Season, despite the fact they were called upon for extra service at the above-mentioned Fairs.

Battery AD–X2 has eased our operational problem; we are therefore, happy to recommend your service on lead-acid batteries.

Very Truly Yours,

TRAM CAR AMUSEMENT CO.,
GILBERT R. RAMAGOSA, *V. Pres.*

D/GRR.

Mr. RITCHIE. Test by the United States Testing Co., Inc., dated January 28, 1953, on Battery AD–X2. Title, "Effectiveness of Battery AD–X2," No. E5296. This report deals with a combination of laboratory and fields tests over a 362-day period.

(The document referred to is as follows:)

UNITED STATES TESTING CO., INC.

HOBOKEN, N. J.

REPORT OF TEST

Test No. E5296, January 28, 1953
Pioneers, Inc., 2411 Grove Street, Oakland 12, Calif.
Material tested: Battery AD–X2
Nature of tests: Effectiveness of AD–X2
By A. S. Mindes, engineering department, United States Testing Co., Inc.

SUMMARY

Object

The object of these tests was to determine the effectiveness of Battery AD–X2 as a lead-acid battery additive.

Procedure

Three groups of batteries were obtained for these tests. Half of each group were treated with Battery AD–X2. All compared groups were given the same discharge and charge procedures. One small group of untreated batteries, however, were given a charge (for sulfated batteries), according to Dr. G. W. Vinal, outlined in the textbook Storage Batteries.

Two groups of batteries were predominantly made of discarded sulfated batteries. The third group consisted of 10 new batteries, 2 each from 5 leading manufacturers, all manufactured approximately during the same period.

Tests were made for charge, discharge, temperature rise, acid specific gravities on all groups of batteries. One group was placed in automobiles for actual road usage tests. The other groups were placed on the storage shelf for discharge and shelf-aging tests.

Results

The use of Battery AD–X2 as an additive is effective, because it increases the charging and discharging efficiency, reduces the internal operating temperatures, does not harm lead-acid batteries, and reduces shedding of active material.

DISCUSSION

The rebuilt batteries obtained for this test were assembled from discarded and sulfated batteries. After these batteries had been rebuilt, one-half were treated with Battery AD–X2. The remaining half, which was left untreated, was divided into two groups: Batteries Nos. 3, 4, 13, 16, and 17 were charged the same way as the AD–X2 treated batteries; batteries Nos. 6, 9, 12, 15, and 18 were

charged by the Vinal method for sulfated batteries. The Vinal method is fully discussed in chapters III, paragraph d, and VI, paragraph e, of Storage Batteries, by George Wood Vinal, published by John Wiley & Sons. This method is recommended as a simple and effective remedy for sulfated batteries. As practiced in the field, to charge a battery by this method would be economically unfeasible.

At the end of the test, examination of the negative plates in all the batteries showed that there were 3 Vinal-charged batteries with excessive shedding to 1 treated battery (No. 11). The Vinal group consisted of 5, and the treated group of 10 batteries.

To test Battery AD–X2 on new batteries, 10 new batteries were purchased, 2 each of 5 leading manufacturers. All purchases were made at the same time; and it was verified that each manufacturer's type were made at the same time. One of each group was treated with Battery AD–X2. Charging, discharging, and temperature comparisons were made between each group, early in the test, after 4 months, and after 1 year on the shelf. At the end of the test, the batteries were recharged, discharged for time and temperature runs, recharged, temperature read, then opened.

Inspection showed almost no shedding of active material in the treated batteries, while the untreated batteries had a considerable amount of shedding. The quality of the separators seemed to be equal in both type of batteries. The positive plates in the treated batteries show a much smoother, darker red brown porous character than the hard, uneven color and texture of the untreated cells. Note photograph No. 11.

OBSERVATIONS

The following observations were made on the batteries under test:

Treated batteries

The negative plates were found with the paste material in a soft and well-adhered condition, with the grid structure quite firm. However, shedding was prevalent on the outer side of the outside negative plates. This was in great contrast to all other negatives. Battery No. 11, which failed, showed heavy disintegrating positive plates, shedding negatives and burnt separators, these characteristics of battery failure are usually a direct result of constant overcharge.

The positive plates of most batteries were quite good, a few were slightly brittle. However, there were two batteries, Nos. 7 and 19, which were showing advanced stages of positive plate disintegration, and the separators turning dark brown. A check on the automobiles which used these batteries showed the regulators and generators working normally.

Untreated batteries

The negative plates of 6 batteries were showing signs of advanced shedding, and with 3 batteries showing the negative grids deteriorating. The positive plates of four batteries are good.

The remaining 6 batteries had 4 with disintegrated positives and 2 with buckled positives. Batteries Nos. 3, 13, 17, and 18, which were charged then left on the shelf for 10 months, showed almost complete deterioration of negative, positive, and/or both plates. Batteries Nos. 6 and 9 failed after 160 and 195 days, respectively. These batteries had disintegrating positive and badly shedding negative plates. The separators were charred to dark brown. Electrical systems in cars using these batteries were checked out as normal.

CONCLUSIONS

On the basis of the tests made, we can come to the following conclusions:

(I) Battery AD–X2 is not harmful to a normal lead acid storage battery.

(II) During charge, cells treated with Battery AD–X2 give a higher specific gravity reading in a shorter time than the similar untreated cells give under identical conditions, starting with discharged, mildly sulfated cells.

(III) On an average, cells treated with Battery AD–X2 operated from 1° to 3° F. cooler than untreated cells, all cells under the identical conditions of charge and discharge.

(IV) Starting with new batteries, treating half of the batteries with AD–X2, and leaving the other half untreated, and storing the batteries under identical conditions for 362 days, the batteries treated with AD–X2 took a charge more rapidly than the untreated batteries, and at 1° to 3° F. lower temperature rises.

Also, each treated battery gave a higher capacity on discharge than their

identical counterpart. All batteries, that is in grouped pairs, were treated identically in regard to charge, discharge, and storage.

(V) Less shedding of active material in AD–X2 treated batteries, with material in a softer condition. Grids are firmer in treated batteries, as against some disintegration in untreated cells.

(VI) Positive plates showed a finer and softer texture of the lead peroxide; color was from red brown to dark brown over the whole plate. In the untreated cells, the peroxide was light red brown clearly defined in the grids and quite brittle. Note photographs Nos. 5–8 and 11.

(VII) Cells treated with AD–X2 showed a higher charging efficiency over untreated cells.

(VIII) Sulfated cells treated with AD–X2 on internal examination were in better mechanical condition than cells charged by the normal and Vinal methods.

(IX) Separators in batteries treated with AD–X2 show less deterioration than those of untreated batteries, conditions of usage being similar in all batteries as far as possible during test.

Senator GILLETTE. Mr. Chairman, may I interrupt or are you following a policy of not interrupting?

The CHAIRMAN. Senator Gillette, yesterday Mr. Ritchie was interrupted so much that it was impossible for him to continue his statement in such a manner that those who would read it could get the sense out of what it was endeavoring to clarify or explain. So, this morning I announced that I hoped Mr. Ritchie would be permitted to make his complete statement and then each and every one would have an opportunity to ask as many questions as he desired.

Senator GILLETTE. Very well.

The CHAIRMAN. For that reason I thought if Mr. Ritchie might proceed and complete his statement, from there on we could proceed to ask him the questions.

Senator GILLETTE. That is perfectly satisfactory.

The CHAIRMAN. If that is agreeable with you, sir, we will let Mr. Ritchie continue.

Mr. RITCHIE. Thank you, sir.

Results:

The use of Battery AD–X2 as an additive is effective because it increases the charging and discharging efficiency; reduces the internal operating temperatures; does not harm lead-acid batteries; reduces shedding of active material.

Insert: Letter from the Katchen Iron Works, Inc., to Mr. I. Dollinger, Battery AD–X2 distributor of New Jersey, dated April 1, 1953. Quoting:

Our trucks are kept outdoors all winter, and in the past we have been frequently troubled by failure to start. It is now slightly over a year since we first used AD–X2, and we find that over the past year we have saved well over $500 in delayed operations.

(The document referred to is as follows:)

B. KATCHEN IRON WORKS, INC.,
148–50 Shaw Avenue, Newark 8, N. J., April 1, 1953.

BATTERY AD–X2
144 Elmora Avenue, Elizabeth, N. J.

(Attention: Mr. I. Dollinger.)

GENTLEMEN: This is to advise you that since we used AD–X2 in our truck batteries, we have not had a single delay due to battery failure.

Our trucks are kept outdoors all winter and in the past we have been frequently troubled by failure to start. It is now slightly over a year since we first used AD–X2, and we find that over the past year we have saved well over $500.00 in delayed operations.

We would give this our highest recommendation to any questioner.

Very truly yours,

B. KATCHEN IRON WORKS, INC.,
LOUIS L. KATCHEN, *Vice President.*

Mr. RITCHIE. Insert letter from Good Humor Corp., dated April 20, 1953, to Mr. Irving Dollinger, Battery AD–X2 distributor, of New Jersey. Quoting:

As you know, due to our complete satisfaction with your product, we have ordered you to treat our whole fleet.

(The document referred to is as follows:)

GOOD HUMOR CORP.,
South 15th Street & 19th Avenue, Newark 3, N. J., April 20, 1953.

Mr. IRVING DOLLINGER,
Dev–T–Co Battery Co., 144 Elmora Avenue, Elizabeth, N. J.

DEAR MR. DOLLINGER: In answer to your inquiry regarding our experience with Battery AD–X2, let me first state that we are more than pleased with the results shown by your remarkable product.

As you know, our vehicles when in operation during daylight hours idle with the ammeter showing discharge. At night they stand still with a great many lights burning. Due to this operating condition practically every battery had to be recharged at least once a week. Our battery replacements ran to 25% and our battery breakdown ran to three to four daily.

Last May you treated 25 of our batteries. Our experience with these 25 batteries is as follows:

1. Only 2 batteries came in once each for a recharge and both vehicles were found to have a short circuit in the electrical system.
2. Absolutely no breakdowns with the above 2 exceptions.
3. Use much less water.
4. Absolutely no replacements. These batteries lasted throughout the season and are still operating.

As you know, due to our complete satisfaction with your product, we have ordered you to treat our whole fleet.

Very truly yours,

GOOD HUMOR CORP.,
ALFRED FAUSEL, *General Manager.*

Mr. RITCHIE. Concluding remarks on Bureau of Standards, it can be seen by the letters inserted in the record that the Bureau of Standards condemned Battery AD–X2, together with all other additives by implication since 1931 to April 1950, whether they were tested or not.

The Bureau of Standards condemned Battery AD–X2 with the full knowledge of its existence over the protest of Dr. Merle Randall, the Oakland Better Business Bureau and many others from April 23, 1948, to April 1950, without even claiming to have tested or analyzed the material.

The Bureau of Standards has condemned Battery AD–X2 through the National Better Business Bureau publication, Battery Compounds and Solutions, over protests, when, by their own admission, they had only tested the material in 1 or, at the most, 2 batteries which we and others have determined were not opened for inspection of the samples prior to testing; and the overcharge shown in the Test Report 504 indicates that the batteries were ruined prior to treatment with the product. That in June 1952, they ran tests on a group of batteries and allowed the acid to go well over 1.280, which action ruined the test. This was allowed to happen over our repeated protests; and, yet, at the Post Office hearing on October 14, 1952, the Director of the Bureau of Standards testified to the fact that the test was run, for all practical purposes, in accordance with the manufacturer's instructions.

He further testified that we had not mentioned the high acid until after the test had begun, when, in fact, it was stated in the original test specification that the acid should not be allowed to go above 1.280. In his letter of April 23, 1952, the Director stated that this was a minor

deviation, but that they would not cut the acid back. In my letter dated to him April 26, 1952, I affirmed the agreement between the Director and myself that he would cut the acid should it go over 1.280. In our last meeting before the test started on June 2, I again protested the high acid situation.

We were found—I was asked about this yesterday—we were found guilty of fraud at the Post Office Department by default; we were not at the hearing. I have a statement here concerning a patent by a fellow by the name of Thomas Edison who had pretty much the same problem that we have. He had a metallic magnesium that, according to theory, would not work, but after he treated it, it did work, and he never was able to explain why it did work or why it didn't fit with theory. This was handed to me last night by a fellow from the Patent Office, and it gives me a little relief to find that someone else had had a similar problem.

We come now to the Air Force tests—United States Air Force tests. Project 892–SA, San Antonio, Tex.; Wright-Patterson Air Force Base; and project P–893–SC, Sacramento, Calif.

The test at San Antonio, Tex., was run on batteries which were contaminated with dirt. I would like to insert into the record an analysis of the two specimens of electrolyte from that test:

KENNETH BONNICKSON, CHEMIST,
3403 Piedmont Avenue, Oakland 11, Calif., October 26, 1948.

PIONEERS, INC.,
2411 Grove Street, Oakland, Calif.

Report of spectrographic examination of sludge from samples of ELECTROLYTE submitted, seal unbroken, by Mr. Jesse Ritchie 10/19/48.

Mark: Project 892–5A San Antonio Texas at request of MCMMXT 5–9–5. Symbol MCMMXT–LBW–em.

Lab. No	1061	1062	Lab. No	1061	1062
Bottle mark	6	12	Bottle mark	6	12
	Percent	*Percent*		*Percent*	*Percent*
Aluminum	1–5	1–5.	Magnesium	Trace	Trace.
Antimony	0.1–0.5	0.05–0.2.	Manganese	.001–.01	.001–0.01.
Arsenic	Trace	Trace.	Silicon	0.1–0.5	0.1–0.3.
Barium	0.5–0.2	0.5–0.2.	Silver	Trace	Trace.
Calcium	1–3	0.5–2.	Sodium	0.1–0.3	0.1–0.3.
Chromium	Trace	Trace.	Strontium	0.05–0.2	0.05–0.2.
Copper	.01–.05	0.01–0.05.	Tin	0.05–0.2	0.1–0.3.
Iron	0.1–0.5	0.05–0.2.	Titanium	0.01–0.2	0.01–0.1.
Lead	Major	Major.			

The above results indicate that this electrolyte has been contaminated with dirt.

KENNETH BONNICKSON.

This analysis indicates that a good portion of the real estate of Texas was probably in these batteries. There was a lot of dirt in those batteries, Senator.

Wright-Patterson Air Force Base: Through the actions of one of our sales representatives, who apparently had more vision for sales than knowledge of batteries, it was recommended that the Air Force treat a battery which had sulfated so badly that the plates of the elements were stuck together in one piece.

In his presence, and under his guidance, I am told, the battery was charged at a very high rate and became very hot. Since it acted under these conditions as a resistor, there are no results from this portion of

the test. This battery was later sent to the Squier Signal Corps Laboratories and became a part of the Signal Corps test.

I would like to make the point here that it is possible for a battery to be sulfated to the extent that the resistance is greater in ohms between the plates than between the cross bars connecting the plates together; that a battery can be charged for a prolonged period of time, passing the current from crossbar to crossbar and forming corrosion on top of the crossbar. This does no particular damage to the battery.

By the same token, if the current breaks through and the battery takes a partial charge, the grid in the positive plate is normally first peroxided out so that the battery would have no capacity even though hydrometerwise it might appear to have taken a full charge.

Along that line, after a battery has sulfated to the extent that the separators and the plates become one piece, it is no longer mechanically sound; and that is what apparently happened in the project at Wright-Patterson Air Force Base.

Sacramento test, project P–893–SC, found the Battery AD–X2 functioned differently from mixtures of sodium sulfate and magnesium sulfate. It found that batteries that "have been treated may be stored for a period of 6 months with no detrimental effects." Again quoting, "Batteries normally stored for 90 days, then recharged, may now be treated and stored for a longer period as sulfation has no effect on a battery in storage. This in itself will save many man-hours that are involved in the transportation of batteries from supply to maintenance and back to supply."

Again quoting, "Authorize this command to treat all automotive type batteries in active use." And again quoting, "War Department Manual TM–92857 be revised."

Remark: The present wording of technical manual TM–92857 precludes the use of Battery AD–X2.

Further quoting, "The results are quite different from that when equivalent amounts of sodium sulfate and Epsom salts are used."

Remarks: This test was transferred to the Office of Chief of Ordnance. Apparently it was for coordination with the Bureau of Standards, Department of the Navy, the Office of the Signal Officer, Department of the Army, Washington 25, D. C. See Colonel Kiehle letter dated February 9, 1949, to Pioneers, Inc., which I would like to make a part of the record.

The CHAIRMAN. It will be made a part of the record.

(The document referred to is as follows:)

HEADQUARTERS AIR MATERIEL COMMAND,
WRIGHT-PATTERSON AIR FORCE BASE,
Dayton, Ohio, February 9, 1949.

Subject: "Protecto-Charge"

PIONEERS, INC.,
2411 Grove Street, Oakland 12, California.

GENTLEMEN: This is in reference to your letter of January 19, 1949, requesting information on the status of battery-test project at Sacramento Air Material Area.

The project was established for evaluating "Protecto-Charge" as a reclaiming agent for condemned automotive batteries which, by visual inspection, are considered to be mechanically sound. Test results were to be compared with present methods of reconditioning batteries manually to determine if monetary and material savings could be effected. Since the test results at Sacramento Air Materiel

Area do not agree with results of a similar project at San Antonio Air Materiel Area, a further study of the product is being conducted.

Action has been taken with Engineering Division, the responsible agency within the Air Materiel Command for research and development of material and equipment, to conduct the above-mentioned study. Engineering evaluation of the product is to be accomplished in coordination with the Office of the Chief of Ordnance, the agency responsible for procurement and supply of automotive batteries for USAF use, the Bureau of Standards, Department of the Navy, and the Office of the Chief Signal Officer, Department of the Army, Washington 25, D. C.

As a result of the above action, the battery test projects at Sacramento and San Antonio Air Materiel Areas have been suspended. Upon completion of the study by Engineering Division, and the availability of findings, your Company will be advised accordingly.

Very truly yours,

EDWARD G. KIEHLE,
Colonel, USAF, Chief, Maintenance Technical Section, Maintenance Division.

Mr. RITCHIE. Letter from Chief, General Supplies Branch, Programs and Requirements, United States Air Force, Wright-Patterson Air Force Base, to Meyers Distributors, Battery AD–X2 representative in Kansas dated May 6, 1953, stating that Battery AD–X2 may be purchased under certain conditions by the Air Force. I would like to make this letter a part of the record.

(The document referred to is as follows:)

HEADQUARTERS AIR MATERIEL COMMAND,
Wright-Patterson Air Force Base, Ohio, May 6, 1953.

Subject: Project P–893–SC, Testing Battery AD–X2 Manufactured by Pioneer's Inc., 2411 Grove, Oakland 12, California.

MYERS DISTRIBUTORS,
1607 North Hillside, Wichita, Kansas.

GENTLEMEN: Reference is made to your letter dated April 3, 1953, subject, same as above.

Research reveals that no specific authorization has been given for the local procurement of subject item. However, in accordance with the provisions of AF Regulation No. 70–16, local purchase is authorized as a normal method for obtaining commercial or specialized type items which are not listed in any AF publication and are essential for base operations.

Very truly yours,

WARD R. BETZ,
Colonel, USAF Chief, General Supplies Branch Programs and Requirements Division, Directorate of Supply and Services.

Mr. RITCHIE. Remarks: Of all the Government tests run, the Air Force test was the only test that was not restricted or classified although it has only been recently that we were able to get a copy of this test.

Chief of Ordnance test: As I mentioned yesterday, none of the batteries were opened prior to the beginning of the test. The batteries were salvaged. The batteries were from salvage, were given two prolonged overcharges prior to treatment.

The test was run for only 6 months, when all the batteries were dismantled. The only controls were brandnew batteries. In the 6-month period it would be very unusual if these controls should fail.

Prior to running this test, Benicia Arsenal had tested the material, and the Chief of Ordnance had written our sales representative on July 9, 1948, over the signature of Maj. Gen. E. S. Hughes that:

> I have this day issued orders that my office take immediate steps to procure and place in use sufficient Battery AD–X2 to do what the test conducted by this Department indicated that Battery AD–X2 can do.

Remarks: Our sales representative had contacted General Hughes, since it seemed we could not get test data from Benicia Arsenal through Detroit Arsenal to the Pentagon. The battery program at Detroit Arsenal was under L. S. Gerber, who received a patent filed on October 19, 1945, issued August 9, 1949, on a battery separator which made some of the same claims for it when placed in lead-acid storage batteries that we made for Battery AD–X2. Shop rights on this patent were assigned to the United States Government, but ownership of the patent remained with L. S. Gerber. I would like to make this patent a part of the record.

The CHAIRMAN. It will be made a part of the record.

(The document referred to follows:)

Aug. 9, 1949. L. S. GERBER 2,478,186

STORAGE BATTERY SEPARATOR

Filed Oct. 19, 1945

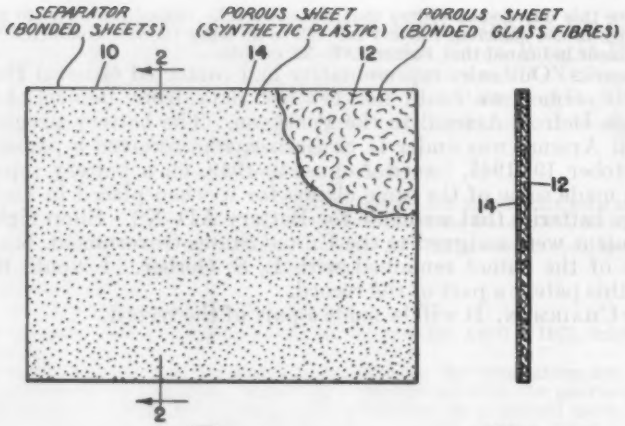

Fig. 1 Fig. 2

INVENTOR.
LIPMAN S. GERBER

BY
J. H. Church & H. E. Hibbeler

ATTORNEYS

Patented Aug. 9, 1949 2,478,186

UNITED STATES PATENT OFFICE

2,478,186

Storage Battery Separator

Lipman S. Gerber, Lakewood, N. J.

Application October 19, 1945, Serial No. 623,427

5 Claims. (Cl. 136—145)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to improvements in storage battery separator plates, and more particularly to a type suitable for dry-charged storage batteries.

In order to more effectively ship and store storage batteries of the acid type, it has been found desirable to use a modified storage battery plate construction which is commonly known as "dry charged." It has been found possible to store batteries of this type for indefinite periods without substantial deterioration and when filled with acid and given a short charge the plates are adequately developed and the initial life of the storage battery commences.

It has been found difficult, however, to obtain an adequate and satisfactory separator which had the required characteristics of low resistance, adequate strength, and one which would stand up not only while the battery was without moisture but also after the battery was put in operation. Micro-porous rubber separators have been the most satisfactory up to this time.

The principal object of my invention is to provide an improved type of battery separator particularly adapted for the dry-charged type of storage battery which will meet the electrical and physical characteristics and be of equal or longer life than micro-porous type of rubber separators.

A further object of my invention is to provide a compound impregnated glass fibre separator combined with a thin sheet of impregnated fibre or plastic material to materially reduce porosity and prevent bridging of the lead compounds through the separator.

Further objects and advantages of my invention will appear from the following description of a preferred form of embodiment of my invention taken in connection with the attached drawing illustrative thereof and in which:

Fig. 1 is a plan view of one form of battery separator with a portion thereof broken away to show the internal construction;

Fig. 2 is a cross-section of the separator shown in Fig. 1.

It has been found that in dry-charged storage batteries a relatively long storage life and a relatively long active life could be obtained by the use of micro-porous battery separators. Shortage of rubber, however, materially reduced the availability of separators and with the increased demand for storage batteries, substitute materials were carefully investigated. At such time the glass fibre separator was again considered but found unsatisfactory, particularly due to the partial bridging of the battery plate material through the open pores of the glass fibres. While such batteries show good cold characteristics the low electrical capacity after an accelerated life test rendered them unfit for their desired purpose.

Fibre glass separators have usually been used in conjunction with wood veneer, but this is satisfactory only in wet batteries for the veneer separates in dry batteries. It is, of course, to be understood that if moisture is present sufficient to protect the separator, there is a constant discharge of the battery.

The objective has therefore been to provide a battery separator having the electrical and physical characteristics of the micro-porous rubber separators without requiring the use of any rubber.

In investigating the phenomenon of the failure of the dry-charged batteries, I observed that the bridging condition was due to the impossibility of controlling to a high and uniform degree the porosity in the fibre structure. Although careful specifications were set forth limiting the density of the glass to .135 centigrams per square inch per mil thickness, which expressed in metric units is

8.238 milligrams per square centimeter per millimeter thickness, and a maximum fibre diameter of .0005 inch or .0127 millimeter was the largest tolerated, it was still noted that batteries failed after as low as 56 charging cycles.

I have overcome the previous difficulties noted and have not only succeeded in equalling but in exceeding the life of the dry-charged battery, using the best known form of micro-porous battery separator by the use of my improved laminated separator. As shown in the drawing attached, this battery separator 10 consists of two principal elements. It includes a glass fibre sheet 12 which may be suitably spun and woven in cross-grain form and which may be provided with a suitable phenolic binder. In addition, as the second element, it includes a thin slightly porous cellulose sheet produced by pressing cellulose fibers closely together into thin matted sheet form through well known processes, or similar partially porous board, coating or film, similarly made of fibres or particles of synthetic resin or plastic material such as Vinylite, the second element being less porous than the glass fiber sheet.

It is recommended that the thin sheet of the fibre or coating 14 be impregnated and bonded to the sheet 12 of glass fibre of the proper thickness by means of a phenolic resin and then passed through an oven of the proper temperature for curing the impregnated fibre coating to make it resistant to the battery electrolyte.

The principal function of this cellulosic or fibrous sheet less porous than the glass fiber sheet is to reduce porosity and prevent the bridging of the lead materials of the respective charged plates. It has the additional advantage, however, of increasing rigidity of the glass fibre sheet and improving the otherwise desirable characteristic of glass fibre separators.

By a suitable choice of materials it is possible to obtain a separator which will not exceed .03 ohm per square inch for a separator of 70 mil thickness.

It is found that this type of laminated separator having the glass fiber sheet bonded to the cellulose or plastic sheet, coating or film as herein described has an especially satisfactory durability, is rigid and easily handled and most effectively prevents treeing or bridging of the lead plate material. If the glass fibres are arranged to run vertically it is possible to permit circulation of the electrolyte and allow for greater cooling, thus further improving the battery characteristics and permitting greater overcharges. The flat impregnated fibre against the negative plate will retain the plate material and help prolong the life of the battery. The glass fibre sheet tends to hold the plate material from dropping from the plates thereby preventing short circuits.

No rubber or other critical materials are necessary and the batteries with this type of separator have a greater effective discharge rate and are particularly useful, both in extremely low and high temperatures starting conditions.

While I have shown and described a preferred form of embodiment of my invention, I am aware that modifications may be made thereto and I therefore desire a broad interpretation of my invention within the scope and spirit of the description herein and of the claims appended hereinafter.

What I claim is:

1. A separator for the plates of a dry-charged acid type storage battery consisting of a laminated structure including a porous sheet of glass fibres held in relative position by a binder material, and a thin slighly porous sheet of synthetic plastic material bonded as a coating to said sheet of glass fibres to reduce porosity of the latter.

2. A separator for the plates of a dry-charged acid type storage battery consisting of a laminated structure including a porous sheet of glass fibres held in relative position by an impregnated binder material, and a thin slightly porous sheet of synthetic resin bonded as a partially porous crating to said sheet of glass fibres to reduce porosity of the latter.

3. A separator for the plates of a dry-charged acid type storage battery consisting of a laminated structure including a porous sheet of glass fibres held in relative position by an impregnated phenolic resin binder, and a thin slightly porous sheet of synthetic resin material bonded by a phenolic resin to said sheet of glass fibres to reduce porosity of the latter and thereby prevent bridging of lead compounds through the separator.

4. A separator for the plates of a dry-charged acid type storage battery consisting of a laminated structure including a porous sheet of glass fibres spun and woven in cross-grain form and held in relative position by a binder material, and a thin slightly porous sheet of synthetic resin material bonded as a coating to said sheet of glass fibres to reduce porosity and thereby prevent bridging of lead compounds through the separator.

5. A separator as set forth in claim 4, in which said porous sheet of spun and woven glass fibres includes glass fibres running vertically with respect to the battery to permit circulation and cooling of battery electrolyte.

LIPMAN S. GERBER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
Re. 16,548	Waddell	Feb. 8, 1927
1,366,223	Wales	Jan. 18, 1921
2,117,371	Slayter	May 17, 1938
2,133,183	Baird et al.	Oct. 11, 1938
2,287,305	Haverbeck	June 23, 1942

FOREIGN PATENTS

Number	Country	Date
763,866	France	Feb. 19, 1934

Mr. RITCHIE. The so-called Ordnance Department test was classified and we have never been able to obtain a copy of the test. Despite this, on April 4, 1953, there appeared in the Washington Daily News the following:

James Davis, Assistant to the Under Secretary of the Army in Charge of Research and Development, said the Army has looked back over its own test on Battery AD–X2 and agreed that the compound is of no value in trucks and buses.

It is interesting to note that, to the best of my knowledge, no truck or bus batteries were included in the test by the Chief of Ordnance. In other words, the test is classified but it can be used, although it was improperly conducted, to condemn our product to the general public through newspapers, while we can't even have a copy of it to find out what happened.

On February 5, 1953, our Virginia distributor received a letter from the Headquarters, Third Army, stating:

However, you are advised that local purchase of AD–X2 is not authorized.

I would like to make this letter a part of the record.

The CHAIRMAN. That will be made a part of the record.

(The document referred to follows:)

HEADQUARTERS, THIRD ARMY,
Fort McPherson, Ga., February 5, 1953.

Mr. FRANK F. COOK,
Vice President and General Manager, Battery AD–X2 Distributors, Inc.
1415 Elizabeth Avenue, Charlotte 4, N. C.

DEAR MR. COOK: This will acknowledge receipt of your letter of January 31, 1953, to Colonel Clyde Massey, requesting that Army installations be authorized to make local purchase of AD–X2.

Colonel Massey has been transferred to another assignment. However, you are advised that local purchase of AD–X2 is not authorized.

It is suggested that you communicate with the Commanding Officer, Raritan Arsenal, Metuchen, New Jersey, or Chief of Ordnance, Department of Army, Washington 25, D. C.

Sincerely,

L. C. ESTES,
Major, AGC,
Assistant Adjutant General.

Mr. RITCHIE. Thank you, Mr. Chairman.

The CHAIRMAN. As I stated earlier, all the requests that you made would be a part of the record.

Mr. RITCHIE. I believe our night's work is paying off, sir; we are making progress.

The CHAIRMAN. I hope you are, sir.

Mr. RITCHIE. The United States Post Office Department notified Pioneers, Inc., March 2, 1952, that there was to be a hearing at the Post Office Department in Washington, D. C., to determine whether we were using the mails illegally.

After various postponements of the hearing date, meetings were held on September 29, 1952, between the Assistant Solicitor of the Post Office Department and various groups on the subject. During the course of the meetings I got the impression, rightly or wrongly, that there would be no hearing of the case on October 13, 1952, as scheduled, until certain tests at MIT were run. Therefore, I did not participate in the hearing which was actually held. We were found guilty of a mail fraud by default.

We filed an application for correction of the default. We filed an application for reopening the case; we filed a further application for the reopening of the case. These motions were denied and a mail fraud order was issued against us in the latter part of February 1953. This was a very unusual fraud order, since it not only included Pioneers, Inc., but all of the officers personally; in other words, all of our personal mail and everything was to be stamped "fraud" and returned to the sender. This order was subsequently suspended by the Postmaster General.

Our business had suffered tremendously from this suspended fraud order. In fact, we have gone downhill financially at the rate of $1,000 per week since that time.

At the Post Office hearing on October 13, 1952, there appeared against us no witnesses outside of the Post Office Department except from the National Bureau of Standards. The array of witnesses from the National Bureau of Standards was probably the greatest parade of scientists ever to appear before a Government agency in the history of the United States. There was present at the hearing the Director of the National Bureau of Standards, the Chief of the Electrochemistry Section, National Bureau of Standards, the Chief of the Statistical Department, National Bureau of Standards, the Chief of the Spectrographic Chemistry Section of the National Bureau of Standards, and four other big names in the Bureau.

Federal Trade Commission: In 1949 when we found we were getting no place with the Bureau of Standards and the National Better Business Bureau, we requested, through the San Francisco office of the Federal Trade Commission, that we be investigated by them. Early in 1950 the National Better Business Bureau filed a complaint with the Federal Trade Commission against us, apparently augmented by the National Association of Battery Manufacturers.

We have cooperated with the Federal Trade Commission up to this date. The Federal Trade Commission came into our shop in early 1950, and, with the assistance of the man who was the former Director of the San Francisco Branch of the National Bureau of Standards at that time, ran tests on our product. We have cooperated

with the Federal Trade Commission since late 1949, and to the best of my knowledge they have never filed a complaint against us.

Bureau of Ships' test: That was in September 1949. These batteries in this test were in dubious mechanical condition to begin with. They had been subjected to a 535-percent conditioning charge prior to treatment, which would be expected to ruin the batteries.

We protested this test over Dr. Randall's signature, but the Bureau of Ships distributed it nevertheless.

One important thing about this test is that in the final report under specific gravities there appear what seem to be the temperatures, while under the initial temperatures there appears the numbers that seem to be for the specific gravity. The present Bureau of Ships' manual on storage batteries precludes the use of Battery AD–X2.

Squier Signal Laboratories: Do you have a copy of the Squier Signal Laboratories' test?

Mr. FORSYTHE. I do not believe so.

The CHAIRMAN. I am informed by the staff, Mr. Ritchie, they do not believe they have it.

Mr. RITCHIE. I thought there was a copy of that, Senator, in the record yesterday.

Mr. FORSYTHE. Is that the green back?

Mr. RITCHIE. Yes, sir.

The CHAIRMAN. That was inserted in the record yesterday if it is the one with the green cover.

Mr. RITCHIE. Yes, sir.

Mr. FORSYTHE. It is the Signal Corps test?

Mr. RITCHIE. Yes, sir. This is a restricted test. However, I have seen the test, and this test is so reported it is impossible to tell what was done. They flatly refused on the 28th of June, 1948, to follow our test procedure as laid out by Dr. Merle Randall. This test was restricted so that we could not obtain a copy for study or criticism, but was widely circulated through all Government battery departments, and was very detrimental to our sales efforts with the Government. As soon as the various agencies learned of its existence, we were treated with suspicion.

I have here purchase orders from the California Tractor & Equipment Co., the Bay Equipment Co., the Buran Equipment Co., the Carnation Co., Dinwiddie Construction Co., the city of Vallejo, and the city of Oakland. I would like to give the committee some idea of how much material Bay Equipment has bought over a period of 5 years; and, Bay Equipment, I might mention, is one of the largest equipment operators in northern California.

The CHAIRMAN. What kind of equipment do they operate, Mr. Ritchie?

Mr. RITCHIE. They operate pick-up trucks, cars, compressors, shovels, drag lines, bulldozers—every type of heavy equipment.

The CHAIRMAN. And those purchase orders were over a period of how many years?

Mr. RITCHIE. Those purchase orders are over a period of 5 years.

The CHAIRMAN. And they continuously used the product in that fleet of motors that required batteries for starting purposes, and so forth?

Mr. RITCHIE. Yes, sir. The last time I separated them from any money was the second month, the 26th day of 1953; that is the date of their last purchase order. Here is the same thing for Carnation Creamery.

The CHAIRMAN. You are just showing that to the committee?

Mr. RITCHIE. I am just showing this to the committee.

The CHAIRMAN. You are not asking it to be made a part of the record?

Mr. RITCHIE. No, sir; it would be too voluminous, sir.

The CHAIRMAN. There were how many companies?

Mr. RITCHIE. There are seven companies.

The CHAIRMAN. If they are not a part of your official record, could they be made a part of the committee files?

Mr. RITCHIE. They are my official records.

The CHAIRMAN. Therefore, you would have to keep them?

Mr. RITCHIE. Yes, sir; I would be very glad to hand them over to the committee.

The CHAIRMAN. In other words, there are how many companies that are listed there with copies of their purchase orders?

Mr. RITCHIE. There are 7 companies; there are 5 companies, and 2 cities, the city of Vallejo and the city of Oakland, Calif.; I simply brought these to show—these are my purchase orders, and I simply brought these to show that apparently these people are pretty well satisfied because over a 5-year period they have given us several hundred orders.

Senator SCHOEPPEL. Mr. Chairman, might I make this request or suggestion to the witness? Mr. Ritchie, would those be available to the committee for reference purposes in the determination of this case? Would you make them available upon request?

Mr. RITCHIE. Yes, sir.

The CHAIRMAN. Then, Mr. Ritchie, they will be held by the committee staff for any members of the committee to examine, to satisfy themselves concerning the purchase orders, but they will be safeguarded so that when the hearing is completed and the committee members have had an opportunity, if they desire, to examine them, the file will be returned to you, sir.

Mr. RITCHIE. Thank you, sir.

Senator SCHOEPPEL. I would like to ask one other question, Mr. Chairman. Do I understand from this witness that these are indicative of the type of transactions that you have had but these do not include all of the business transactions which your company has been involved in?

Mr. RITCHIE. No, sir. When I started back this time I simply asked one of my girls to pick me up 5 or 6 of the purchase orders out of the file from our old customers. A considerable amount of this is batteries that were treated by us in our own shops; a considerable amount of it is where the customer bought the Battery AD–X2 and treated batteries themselves, where they bought new batteries from other people, but every battery involved here is treated with Battery AD–X2.

The CHAIRMAN. And they continued to be customers over a period of 5 years?

Mr. RITCHIE. Yes, sir; and they are still customers. In fact, some offered to come back here at their own expense to testify. I believe that finishes my statement, Mr. Chairman.

The CHAIRMAN. Then, as chairman, I will pass and shall not ask you any questions at this time in order that the other committee members here may be privileged to do so. I will turn you over to the senior member of the minority party, the man who was chairman of this committee when this question first came before the committee, Senator Sparkman.

Senator SPARKMAN. Mr. Chairman, I had to leave yesterday to help write up the housing bill, so I did not get to hear Mr. Ritchie's testimony yesterday morning except the first part of it, and I have just asked for a transcript of it. I would rather pass and let other members ask questions, and ask some later.

The CHAIRMAN. Senator Schoeppel, do you have any questions?

Senator SCHOEPPEL. Mr. Chairman, I was delayed in getting back to Washington yesterday by old man weather who grounded some planes, and I am sorry I was not present when you first testified, Mr. Ritchie.

I want to have time to check your testimony; the first opportunity I have had was this morning a few moments ago, and I have not gone into it thoroughly.

I would just like to ask you about 2 or 3 questions, and then ask you this, sir, and the committee: In the event, as we go into this thing it requires further testimony from you, will you be available for recall or would you be willing to come back and answer questions for some of the committee members who were not permitted to be present because of other activities?

Mr. RITCHIE. Senator, we are under a suspended fraud order from the Post Office Department. That is something like being on parole from jail. We cannot do any business, so I intend to remain here in Washington, and make myself available at all times to this committee to answer any questions that they might have. In fact, I hope to be called back as a final witness to recap some of the work.

The CHAIRMAN. Senators Sparkman and Schoeppel, Mr. Ritchie presented the committee with a chart yesterday showing the volume of sales in the early years of his business, and to what volume it had grown, then the reduction in sales as the various governmental reports and the fraud order of the Post Office Department were issued against him, and that chart is over there to our left. Senator Schoeppel, if you care to look at that chart you will probably gain an opinion as to what the effect on his business has been because of the report of the Bureau of Standards and the Post Office Department. If that is not a correct statement of your chart I would like to be corrected, Mr. Ritchie.

Mr. RITCHIE. I believe the chairman has a profit-and-loss statement in his file that the chart was taken from, and also the Dun & Bradstreet report supporting the chart.

The CHAIRMAN. Well, my comment was about what the financial statement would show if that chart is part of your financial statement.

Mr. RITCHIE. Yes, sir; it is. I might state, as I pointed out yesterday, we know of no consumer complaint. The National Better Business Bureau, the National Bureau of Standards, nor any of the

local better business bureaus have ever had a recorded complaint, to our knowledge, and it might be interesting for the committee to know that we have sold from July 1949 up until March 31, 1953, 456,000 some-odd dollars of Battery AD–X2, which represents a little short of a half million treatment pakages.

The CHAIRMAN. Senator Schoeppel, you may proceed.

Senator SCHOEPPEL. Did the report of the Sacramento Air Force test recommend a change in a military technical manual?

Mr. RITCHIE. Yes, sir; it recommended the basic military manual on the maintenance and care of storage batteries be changed so that the material could be used under its present wording where Battery AD–X2 is precluded from use by the armed services.

Senator SCHOEPPEL. I believe you stated that the man in charge of the Detroit Arsenal test had a patent on a new separator. Now, would that separator be in competition with AD–X2?

Mr. RITCHIE. To this extent, Senator: We are attempting to prolong the life of a battery, and our material, while we don't claim it in our advertising, does cause a battery to run cooler. Gerber claims in his patent that his separator caused the battery to run cooler; he also claims longer shelf life in dry-charge batteries. We claim we can maintain longer shelf life in wet batteries. So they are in competition with each other.

Senator SCHOEPPEL. Now, in checking your testimony and listening to you this morning, did I understand you to say that the Bureau of Ships recommended use of AD–X2?

Mr. RITCHIE. No; they do not.

Senator SCHOEPPEL. I want to be sure of that.

Mr. RITCHIE. They condemned the product flatly, and sent out publications to everyone with whom they had correspondence, apparently, saying that the product was worthless when actually they ruined the samples before they were treated with Battery AD–X2, and Dr. Randall so told them.

Senator SCHOEPPEL. I will defer further questioning, Mr. Chairman.

The CHAIRMAN. Senator Gillette?

Senator GILLETTE. Mr. Chairman, I cannot claim the same excuse my colleagues have, that I was not here yesterday. I was here, but my lack of information on batteries and chemistry is such that I cannot ask very many questions—but I heard the testimony.

I want to ask 2 or 3 questions of this witness: One is with reference to the United States Testing Co., Inc. What sort of an organization is that?

Mr. RITCHIE. Well, Senator, I understand that they are the largest and probably the best-known testing company in the United States. Pittsburgh testing may be pretty close to them, but it is my understanding that the United States Testing Co. is probably one of the most outstanding testing organizations in the United States of America.

Senator GILLETTE. What sort of testing?

Mr. RITCHIE. They test everything from rubber balls to ladies' hose, to military equipment. They do a great deal of work, I understand, for the Government, under contract, in electronics, and they are a general testing laboratory. They have been written up any number of times in Reader's Digest.

Senator GILLETTE. Where are they located?

Mr. RITCHIE. Hoboken, N. J.

Senator GILLETTE. Their name is United States Testing Co, Inc.?

Mr. RITCHIE. Yes, sir.

Senator GILLETTE. Do you know why they used that name "U. S." Are they an agency of the United States established by the United States?

Mr. RITCHIE. I have looked them up in Dun & Bradstreet, and their board of directors is tremendously impressive. Du Pont, for instance, has a man on the board. I think that practically all the large companies do. As to the name, Senator, I have no way of answering your question.

Senator GILLETTE. I'm not critical of their ability or the work they are doing; I am wondering why a private agency, not an agency of the United States Government, is doing business under the name of U. S. Testing Co., Inc., which is not a United States agency?

Mr. RITCHIE. I believe the U. S. Tire is also called the United States Tire Co.; is it not?

Senator GILLETTE. Yes.

Mr. RITCHIE. I can't answer that. I know we had an awful time getting a name for our product because every name that we tried was either flamboyant or overdescriptive or something, so we just cut the formula down a little bit now, and the name has very little to do with the product except to a chemist.

Senator GILLETTE. I want to ask you one question with reference to the chart. You called attention to the chart yesterday and the adverse effect of various actions on your business. But I was very much interested, and did not get a chance to ask you about the first quarter of 1953, when your business was quadrupled from the last quarter, the last 2 quarters of 1952. It jumped up to February 10 in that first quarter—yes, more than quadrupled. To what do you attribute that abrupt increase in business?

Mr. RITCHIE. Well, No. 1, we felt that we were vindicated, so our attitude toward the whole thing was changed. No. 2, I went home. I had been here in Washington since back up there in March, and my outfit was kind of an orphan. I have a very good organization, but it is like the Senator's office, when he is not there, it does not run quite like it does when he is there, and I had been away from my office.

The CHAIRMAN. Mr. Ritchie, you just confine yourself to your business. Our Senators' offices do run.

Mr. RITCHIE. Unfortunately, Mr. Chairman, mine doesn't. [Laughter.] But the fact is I was home for 3 months, and we sold quite a lot of materials to Canada. It is a very strange thing, but we are selling quite a lot of material outside of the United States. It is a lot easier to sell outside the United States than inside the United States with this argument with the Bureau of Standards.

Senator GILLETTE. Then your explanation of that five or six hundred increase in percentage of sales is that it was due to the fact that you were home?

Mr. RITCHIE. A good part of it was due to the fact that I was home. Another good part of it was due to our mental attitude because we felt, after Senator Sparkman's committee had gone through this thing

and brought forth facts which we had long known, and which were made public at that time, that we were exonerated. We felt that the argument was over.

Senator GILLETTE. Well, was it not more important than the fact that your mental attitude had been changed to optimism, the fact that the mental attitude of your customers had been changed?

Mr. RITCHIE. I believe that had a great deal to do with it.

Senator GILLETTE. After all, your sales were with them.

Mr. RITCHIE. That is right; we got orders in those days where we had tests going for 6, 8, 9, 10, 11, 12 months, with everybody sitting around for their batteries to fall apart because the National Bureau of Standards said it was no good, and when that test came out, when that report came out, it gave the people confidence.

Senator GILLETTE. What report do you refer to then?

Mr. RITCHIE. I refer to the report of December 18, in 1952.

Senator GILLETTE. By whom?

Mr. RITCHIE. By the Senate Small Business Committee under the chairmanship of Senator Sparkman.

Senator GILLETTE. Well, that is what I was trying to reach, the marked effect of the work of this committee under the able chairmanship of the Senator from Alabama.

Mr. RITCHIE. I would like to go further and say that the so-called Sparkman Committee on Small Business at that time was the only body in Washington that would touch us with a 10-foot pole.

Senator GILLETTE. Then the abrupt drop, the second quarter of 1953, of course, I presume you attribute to the action of the Post Office Department?

Mr. RITCHIE. The mail fraud order murdered us.

Senator GILLETTE. Yes. Do you know of your knowledge who made the complaint to the Post Office Department?

Mr. RITCHIE. I have no knowledge. I have lots of rumors. I have no personal knowledge. The rumor is that the complaint was made by a liaison man between the Bureau of Standards and the Post Office Department.

Senator GILLETTE. The first information your company had of it was when notice was served on you. Was it served on you or sent by mail?

Mr. RITCHIE. It was sent by registered mail and received by my vice president.

Senator GILLETTE. You have put that into the record, have you not?

Mr. RITCHIE. I believe that it is in the record. I think I read it into the record here. I don't believe I read it into the record as to who received it.

Senator GILLETTE. If it is not in the record, Mr. Chairman, I should like to have in the record the initial action by which the Post Office Department proceeded against this company.

The CHAIRMAN. Later on the Post Office Department will be called upon to give us the history as to exactly when and in what manner it came to them, but we can insert it in the record at this point should you desire it.

Senator GILLETTE. Mr. Chairman, if it is to be developed later in the production of evidence it will serve the purpose.

The CHAIRMAN. It will be developed.

Senator GILLETTE. There will be developed what we have in mind. Mr. Ritchie, you have spoken 2 or 3 times of the fact that action was

suspended by the Post Office Department. That, of course, will be developed also, as the chairman has indicated.

I was interested also in your reference to the fact that various tests that were conducted by Government agencies were classified.

Mr. RITCHIE. Yes, sir.

Sentor GILLETTE. This was a test of a commercial product that was before the public for private sale?

Mr. RITCHIE. Yes, sir.

Senator GILLETTE. Do you yourself know of any reason why a test of a commercial product that was being sold for commercial purposes should be classified by any Government agency?

Mr. RITCHIE. No, sir. Senator, I have always been mystified by that. If the tests had been good and we had been attempting to use them for advertising purposes there might have been some justification for it; but to test a product and not even allow us to see what they had done, and then condemn the product publicly on the basis of those tests, as Mr. Davis did on April 4 through the Washington News and Washington Post, is utterly mystifying to me.

Senator GILLETTE. One more question: You have repeatedly referred in your testimony and by reading correspondence which you have placed in the record to the assertion of the National Bureau of Standards that they would—I read from a statement before me:

> We would like to stress again that it is the established policy of the National Bureau of Standards neither to approve nor condemn any specific proprietary products. Brand-name products are not referred to in any publications of the Bureau. Materials are identified by their chemical composition.

Do you claim that rule was violated with reference to your product?

Mr. RITCHIE. Technically, no; in fact, yes. In their own publications they do not condemn the product by name, but they corresponded with the National Better Business Bureau, named the product by name, stating that it was of no value, and with the permission of the Directors of the Bureau of Standards the National Better Business Bureau reproduced these pamphlets in any number that they wanted to, condemning the product by name. And these publications were distributed by battery salesmen as standard equipment with them.

Senator GILLETTE. In your opinion, that contravened their announced policy of not condemning an article by name?

Mr. RITCHIE. Factually it does; yes, sir.

Senator GILLETTE. That is all, Mr. Chairman.

The CHAIRMAN. You stated that certain batteries had dirt in them. You were referring to the batteries that were located down in Texas?

Mr. RITCHIE. Yes, sir.

The CHAIRMAN. You stated that they had dirt in them?

Mr. RITCHIE. Yes, sir.

The CHAIRMAN. Where were these batteries used in the test that you had reference to?

Mr. RITCHIE. The test was set up—that is kind of a mystery, because the test was set up, as I understand it, on the same orders to Sacramento and San Antonio, and the fellow at San Antonio, according to a man who visited me and had seen the literature at San Antonio, said the man went back of the shed there, picked up a bunch of batteries that had the caps off them, and used them in the test.

The CHAIRMAN. How would dirt in batteries affect the test?

Mr. RITCHIE. A battery is a very sensitive animal, and in any dirt there is iron, a certain percentage of iron. Unless there is something to counteract it, it would ruin the battery. In other words, when you get dirt in a battery you have got trouble regardless of what the dirt is. Like down in Arizona, we have an awful lot of water, gyp water.

The CHAIRMAN. Well, they used to, you know, recommend distilled water only for the water that you put in the batteries.

Mr. RITCHIE. Yes, sir; and batteries lasted a lot longer, and would yet if they did that also.

The CHAIRMAN. So that you do not put in any of the minerals or any dirt that the water might contain if you were using distilled water?

Mr. RITCHIE. Yes, sir. You used distilled water in order to get away from these impurities, and these particular batteries in Texas not only had the impurities that would be normally suspended in liquid, but they also had a lot of the terra firma of Texas.

The CHAIRMAN. Why did they run a test down there in Texas on these batteries? What brought about the tests?

Mr. RITCHIE. Well, we had a salesman at that time who was quite active. I think he visited Wright-Patterson Air Force Base. But, actually, what caused the Air Force to run the test, as I understand it, was that some of their personnel visited Benicia Arsenal and Benicia Arsenal had saved an awful lot of batteries there shipped in from the South Pacific. On their visit to Benicia Arsenal they became convinced of the success they were having there, and so they instituted this test. The Air Force, up until the time this test went under the jurisdiction of the Ordnance Department, was a very fine bunch of fellows to work with. I think I visited them twice or something like that. There was none of this secretiveness that you normally get around Government battery shops. In other words, they were quite open as to what they were doing, what they were trying to do, and how they were doing it. They were suspicious of sodium sulfate and magnesium sulfate, and had their chemists mix up the salts in the same proportions of AD–X2, I think, and they varied each direction in certain ways and tried those to find out the thing that we already knew, that the salts, while they would help in desulfating the battery, would cause the active material to shed, while with the AD–X2 that they used, as they reported, they got the desulfation of the battery, were able to leave the salts in the battery, and they had no shedding, and the active material was in very good shape.

The CHAIRMAN. When they took these old discarded batteries that you say some of the screw caps were off, and brought those in and put they under test, were they trying to cooperate with you at that time?

Mr. RITCHIE. That was not the Sacramento test; that was the San Antonio test.

The CHAIRMAN. I am referring to the San Antonio test. Were they endeavoring to find whether the product was of any benefit or were they endeavoring to make a case against you?

Mr. RITCHIE. Well, I wouldn't know, Senator. You would think that if a man was cooperating or taking any interest in his work that he would open his batteries and make sure that the batteries were suitable for tests. Now if he opened a battery and found out they were full of dirt, why, naturally, he would, (1) wash the batteries out,

and make sure that they were suitable for test; or, (2) he would reject those and select batteries that did not have dirt in them.

Now, under those conditions, where the batteries are dry, a separator, a wooden separator, has about 3½ million pores to the square inch in it. That is so these little ions can pass back and forth. A rubber separator has about half that amount. So, if you get dirt in a battery to any extent, that means the battery was open and the separators are probably dry.

Now, when the separator is dry it becomes an insulator; in other words, once the pores close up, you can't soak a battery and get the porosity back in the separator.

The CHAIRMAN. You made reference to a Thomas Edison patent in your earlier statement. Could you repeat that? What significance did that particular Thomas Edison patent have in your problem?

Mr. RITCHIE. Well, he had worked the problem out theoretically on an electric action, and it would not work. It remained in there. So without changing the ingredient, but simply changing the process, he was able to treat this material, although he couldn't explain why the electrolyte worked. According to this, Edison said:

> I am not able to positively account for this special result.

Then it continues:

> After giving a possible explanation, Edison adds: "Whether this is the true explanation of the results which take place or not, it is a fact that by subjecting the solution to the treatment the objectionable foaming is eliminated."

He never changed any materials; he just simply processed the ones that he had through this process, and it worked. He could not explain it.

The CHAIRMAN. Has the Bureau of Standards, to your knowledge, ever contacted you since on AD–X2 to get first-hand information about their experience?

Mr. RITCHIE. Not to my knowledge; no, sir.

The CHAIRMAN. Has the National Bureau of Standards ever contacted the United States Testing Co., to your knowledge?

Mr. RITCHIE. Not to my knowledge; no, sir.

The CHAIRMAN. During the period the Bureau was refusing to test AD–X2, it did publish a paper, Material on Battery Additives. Do you know why this was done or any of the circumstances behind it?

Mr. RITCHIE. No, sir; I do not. We had a great deal of correspondence. What the Bureau had done, they had simply taken the 1931 Letter Circular 302, and made a rehash of it, and put a March 1949 date on it, and sent it to the National Better Business Bureau for duplication and, as far as I know, Battery AD–X2 was the only battery additive on the market at that time, of any consequence, at least.

The CHAIRMAN. How long a time would be necessary to make an actual and thorough field test on the product AD–X2?

Mr. RITCHIE. I couldn't answer that, Senator. We have been in business pretty near 6 years now, and our tests are not completed, because some of the batteries first treated are still in service.

The CHAIRMAN. You mean to say an ordinary car battery you treated 6 years ago is still in service?

Mr. RITCHIE. Yes, sir; and we have batteries——

The CHAIRMAN. The average battery has about an 18-month guaranty or a possible 24-month guaranty?

Mr. RITCHIE. Well, the guaranty on a battery means very little, Senator.

The CHAIRMAN. I know, but if you are a purchaser, and you go to a shop, and you buy a battery, and a certificate is given to you which says "This battery is guaranteed 18 months," providing you have not abused it or broken a connecting post or something, the guaranty is for 18 months. The date is stamped on the battery, and if the battery does not survive the 18 months, you take it back to a service station, and they will usually make a refund and grant you the difference in the number of months that that battery has failed to render service. Eighteen months to 2 years are about the maximum, are they not, on a storage battery?

Mr. RITCHIE. Yes, sir; but our warranty is that the battery won't go 18 months or 24 months.

The CHAIRMAN. I beg your pardon?

Mr. RITCHIE. I say they guarantee the battery from 18 to 24 months, and in some cases 36 months, but the proposition being that if you bring the battery back you pay for the months you used it, and they will allow you for the unused months, so what they are doing is renting you a battery.

The CHAIRMAN. That is right. In answer to my question as to how long it would be necessary for a field test, you say that you have been at it now for about 6 years, and you still have not found the answer, because some of those batteries are still in use, and they were batteries with a guaranty of probably not to exceed 36 months.

Mr. RITCHIE. Well, these particular batteries I have reference to were sulfated batteries which were treated out of the junkyard, and they had no life expectancy to begin with. I know where there is one of them; it is in an electroplating machine.

The CHAIRMAN. That is true. What I was trying to get at, Mr. Ritchie, is simply this: If a new test is under way, and it is to be a field test, how long would you expect it would be necessary to get an actual and thorough field test?

Mr. RITCHIE. Well, you would treat your batteries, and you could expect in the United States the average life of an automobile battery at this time, I believe, to be about 14 months. So, you would have 14 months before your untreated batteries—some of which would still be going, some of which would drop out before that—but you would have about 14 months before you actually had a substantial showing.

The CHAIRMAN. I think you are a little low on 14 months.

Mr. RITCHIE. It could be.

The CHAIRMAN. Most of the batteries that we use will last as long as the manufacturer guarantees, which is usually 18 or 24 months. There is usually a defect in the battery if it breaks down within the 14 months.

Mr. RITCHIE. Well, Senator, you are up in a country where you have agreeable weather, and what breaks the average battery life down in the United States is the fact that your sulfation doubles with every 18-degree increase in heat. It is not unusual to lose a battery in Arizona in 60 days.

The CHAIRMAN. Because of the excessive heat?

Mr. RITCHIE. That is right.

The CHAIRMAN. It is not unusual to pull a battery down excessively in 30 below as it often is in the northern country in the winter months.

Mr. RITCHIE. Strange as it may seem, Senator, you could store a battery in cold storage, zero degrees, and the shelf life of the battery, while it loses charge, the shelf life of the battery——

The CHAIRMAN. You do not follow me, Mr. Ritchie. In the event you have difficulty in starting a motor and you pull that battery clear down to a point where it just barely turns the motor over, then your mechanism on your generator and the automatic controls, and so forth, will permit a very high generation until that battery is brought back to maximum strength. Therefore, you have a very high rate of charge for a period of the first several hundred miles that you are driving, as that battery is being recharged. Now, that in itself is difficult for a battery to take, because you are getting an excessive charge into the battery.

I am not a battery expert. I am just talking now from common experience and just plain commonsense. What I am trying to get at is that if there is a field test under way, how long could we expect it would be necessary to await the final results of that field test? The only reason why we called this hearing was to try to get at some of these facts, because there is a new test under way, and I am just trying to find out how long we could normally expect before a field test would be completed on a battery.

Mr. RITCHIE. Well, that would depend to a great extent on what portion of the country you are running it. If you are running it in the Southern States, I would say probably a year and a half would do it. If we are running it up in your country, I would probably say it would take 2 years, because even though you feel you are abusing your battery in your country in this cold weather, that is not a permanent abuse; the permanent abuse is the hardening of the plates you get in the Southern States.

The CHAIRMAN. Excessive and high temperature will harden the plates?

Mr. RITCHIE. That is right.

The CHAIRMAN. When the plates become hard, that is when it deteriorates, because the segments break down?

Mr. RITCHIE. Yes, sir. It does not occur in cold weather.

The CHAIRMAN. And you contend that your product will help prevent the hardening of the plates and thereby you lessen the danger of a general breakdown?

Mr. RITCHIE. Yes, sir.

The CHAIRMAN. The next is Senator Hunt. Doctor?

Senator HUNT. Mr. Ritchie, you sell, also, a battery service, do you not, a reconditioning service?

Mr. RITCHIE. We sell batteries that we have reconditioned; yes, sir.

Senator HUNT. Don't you advertise the selling of a reconditioning service along with your additive?

Mr. RITCHIE. No, sir.

Senator HUNT. At least, your literature so states.

Mr. RITCHIE. The service end of the situation is simply an accommodation.

Senator HUNT. Will you describe the reconditioning of a battery, what that means, exactly?

Mr. RITCHIE. Well, No. 1, we practically discontinued that operation; No. 2, in reconditioning a battery we take and select batteries from the junk people where they will sell them to us, and we pull the battery, check the mechanical condition of it, check the extent of deterioration of the positive grid as to whether or not the battery has been charged to the point after it becomes sulfated that the grid is no longer stable; then we put the battery back in the case, put it on a charging line, and within 30 minutes we treat it with Battery AD–X2 to lower the resistance in a sulfated material, so that we, ourselves, do not peroxide out the grid on the positive grid.

We charge the battery up, keeping the acid below 1.280 until after the gassing voltage of 2.5 has been reached. We then adjust the acid to 1.280 or below, sell the battery to the customer, with a 1-year full money-back guaranty on it.

Senator HUNT. The question I would like for you to answer, if you can, in the increase of efficiency or the longer life that has been added to that battery, what percent is due to the reconditioning by the various means you speak of, various steps taken, and what percentage is due to the addition of the battery additive?

Mr. RITCHIE. Well, I could answer that question this way, I believe, Senator. Battery shops that rebuild batteries or recondition them without the use of the additive, give no guaranty on a reconditioned battery. We, on the other hand, give a 1-year full money-back guaranty, and we are very disappointed if our customer doesn't get 2 years out of the battery.

Senator HUNT. Well, will you answer my question if you can: What percentage of the increased life is due to the reconditioning and what percentage is due to putting in the additive?

Mr. RITCHIE. I would say, on the basis of our years of experience that probably 75 percent of it is due to the additive, and 25 percent of it is due to the reconditioning.

Senator HUNT. That is all I have, Mr. Chairman.

The CHAIRMAN. We will go to Senator Smathers. I am trying to alternate from left to right, here, and I do not have many on the right side of me, and, therefore, I am turning to the left here more and more. Senator Smathers?

Senator Schoeppel, I was not minimizing your importance, sir, but you had asked questions.

Senator HUNT. Mr. Chairman, don't you think that remark about your turning to the left should be deleted from the record?

The CHAIRMAN. I am only referring physically to my left hand. [Laughter.]

Senator GILLETTE. Also, Mr. Chairman, the Democrats are usually on the right side. [Laughter.]

The CHAIRMAN. This is a hearing; this is not a debate between the Senators.

Senator SPARKMAN. In the last few days they say they have been in the majority, too.

The CHAIRMAN. Senator Smathers?

Senator SMATHERS. Mr. Ritchie, yesterday I asked you about whether or not it was possible for a good chemist to analyze all the ingredients in your formula and be able to tell just exactly what was in it, and I think at that time you stated that that was true and, as

a matter of fact, the Bureau of Standards had been able to tell you some things in it that you had not realized before.

Now, I meant to go on and ask you the further question: Is it not possible for a good chemist to be able to take several of those little powder packages which you have, and tell you how much each ingredient in it weighs, and be able to tell you exactly what your formula is?

Mr. RITCHIE. Well, Senator, I am not chemist enough to answer your question. I have heard it discussed pro and con, as you probably imagine, over these years, by men far more versed in the art than I am, or ever expect to be, or even want to be, for that matter, and I am just not chemist enough to answer that question. Frankly these trace elements have been kicked around a great deal; a catalyst has been kicked around a great deal; an inhibitor has been kicked around a great deal; and I am frank to admit I don't know whether it is the trace elements that do the job, or whether the treatment given the material does the job. We never claimed it had a catalyst in it.

Senator SMATHERS. Well, you put the same ingredients in your formula every time, do you not?

Mr. RITCHIE. Yes, sir. I mean up to the point that we know what we are putting in; beyond that, no.

Senator SMATHERS. That is right; and I presume in some powder or other form. So, would it not be possible for some chemist, some good chemist—I guess you would call him a qualitative chemist—to be able to figure out exactly what you have got in your formula?

Mr. RITCHIE. Well, I had a lot of confidence in this fellow Randall. He wrote a lot of books, wrote a lot of papers.

Senator SMATHERS. Well, now, you would not have confidence in him just because he wrote a lot of books, would you?

Mr. RITCHIE. Yes, because they were good books, the boys tell me. I can't understand them myself, but they tell me they are pretty good books; and he told me not to be concerned about it.

Senator SMATHERS. Well, is it not a fact that actually, so far as this being a secret formula is concerned, any good chemist would be able to analyze first the ingredients which you have in your powder, and in looking at the same packages, which apparently are the same size and of the same weight in each instance in which you make them, they would be able to tell you what percentage the various ingredients are and, therefore, be able to determine easily what the formula is?

Mr. RITCHIE. I doubt it very much, sir.

Senator SMATHERS. Does not the Bureau of Standards claim they know everything that is in your formula?

Mr. RITCHIE. The Bureau of Standards go farther than that; they claim they know everything.

Senator SMATHERS. That is right. As a matter of fact, does not everybody who has ever tested it claim that they know exactly what ingredients are in it?

Mr. RITCHIE. No, sir; most of the learned men with whom I have worked on it, have expressed the opinion that it did not make a great deal of difference what it is made of.

Senator SMATHERS. That is—let us just not talk about whether it makes any difference, let us find out what is in it first. Don't they all say they know what is in it?

Mr. RITCHIE. No; I don't think I have run into anyone stupid enough to tell me that, yet.

Senator SMATHERS. Have you ever run into anyone, some chemist, who conducted a test on this who told you they didn't know what was in it?

Mr. RITCHIE. Yes; many of them.

Senator SMATHERS. Who was that?

Mr. RITCHIE. Well, I believe I was told that a number of times at the Massachusetts Institute of Technology; when I was testing batteries I was told that.

Senator SMATHERS. Let us just stop with MIT. Did they tell you, in analyzing it—did they ever tell you they could not tell you what chemical ingredients you had in AD–X2?

Mr. RITCHIE. I don't believe they told me that they analyzed it.

Senator SMATHERS. Did they tell you that they did not know what the ingredients were in AD–X2?

Mr. RITCHIE. They didn't seem to show a great deal of interest in what was in it.

Senator SMATHERS. Did they tell you they did not know what was in it?

Mr. RITCHIE. I believe so; yes.

Senator SMATHERS. Are you sure of that?

Mr. RITCHIE. No, sir; I am not.

Senator SMATHERS. As a matter of fact, earlier you admitted that any good chemist could tell what ingredients actually were in it.

Mr. RITCHIE. If I did, I was in error.

Senator SMATHERS. Is it not possible for—let me go back. Then it is your opinion that a chemist is not able to take the powder which you have and analyze it and tell you what is in it, what are the ingredients which make it up; is that your opinion?

Mr. RITCHIE. No, it isn't; it isn't my opinion.

Senator SMATHERS. I want to just find out what is your opinion. I am having a hard time of it.

Mr. RITCHIE. Could I answer your question, Senator?

Senator SMATHERS. Surely.

Mr. RITCHIE. It is my opinion that what is in it doesn't have a great deal to do with the subject matter at all. It is what it does.

Senator SMATHERS. I know. But that is not the point we are talking about. I am trying first to find out if we can find out what is in it, and then whether or not it has much to do with it, I do not know. We will talk about that later. But first, is it not possible for a good chemist to be able to analyze your powder there and tell you every ingredient in it?

Mr. RITCHIE. I am not chemist enough to answer the question.

Senator SMATHERS. All right. Now, did the Bureau of Standards ever conduct a test on this additive that you participated in?

Mr. RITCHIE. Yes and no. I have seen a test hookup after they got the test hooked up, and I have seen the plates and the batteries after they boiled them apart in high acid. But I did not participate in the test beyond those two visits.

Senator SMATHERS. Were you there when they got this arrangement that you are talking about, when they made this hookup?

Mr. RITCHIE. I wasn't there when they made the hookup; no. They made the hookup——

Senator SMATHERS. What part of it did you see?

Mr. RITCHIE. I saw the batteries sitting on the table after they had hooked them up. I saw the batteries after they were taken off the table and torn apart. I saw—no, I didn't see the batteries. I saw the plates of the batteries.

Senator SMATHERS. Did you see them pour in the additive or the formula?

Mr. RITCHIE. No, sir; I did not.

Senator SMATHERS. Did you have any reason to believe that they did not do it correctly, or follow instructions?

Mr. RITCHIE. Yes, sir; I did.

Senator SMATHERS. And what made you come to that conclusion?

Mr. RITCHIE. Well, I have built a few batteries down through the years, and there are certain things that you do in building batteries, certain things that you do in diluting acid in batteries, certain things that you do in order to turn out a functioning battery.

Senator SMATHERS. Now, let me go back. What was it that made you think that the Bureau of Standards did not use your formula just right when they ran their test? What evidence led you to that conclusion?

Mr. RITCHIE. Their report.

Senator SMATHERS. And what did their report say?

Mr. RITCHIE. Their report reported no voltages, which we needed to tell what was going on; hydrometer readings were taken at 2-hour intervals, and treated as simultaneously. No water losses were given. Those things are important. But the thing that was detrimental to the test was that they let the acid in the batteries go far above normal acid for a battery, especially a battery in a sulfated condition. That one point alone ruined the test.

Senator SMATHERS. Now, as I understand it, you alleged certain things which they did not do. Are those things on the directions of your additive, of your secret formula, to be followed by people who buy your formula?

Mr. RITCHIE. Yes, sir; they most definitely are. They have been there every year.

Senator SMATHERS. And what you are saying is that the Bureau of Standards, in conducting the test, did not follow your directions?

Mr. RITCHIE. That is true; yes, sir.

Senator SMATHERS. And you say that the reason you know that, is because in their findings they did not say that they followed those directions specifically?

Mr. RITCHIE. No, sir. The numbers given in their report and the wording in their report did not confirm our instructions in our basic literature.

Senator SMATHERS. Now, I do not know that I follow you exactly, but let me ask you this. Did you talk with anybody at the Bureau of Standards about not following the instructions which you give in the use of your formula?

Mr. RITCHIE. Yes, sir; I did. I discussed it with the Director any number of times. I wrote letters on it. Some of the letters I have just finished making of record here.

Senator SMATHERS. And did you discuss with him this test, and did you tell him that you did not think that he had followed your instructions accurately, and, if so, then what did he say?

Mr. RITCHIE. I wrote him a letter on July 14 before I received a copy of the test and pointed these things out. I pointed out that they were going to happen, in a letter to him on May 26, 1952. I pointed that out to him in the original test specifications, which were delivered to him in March of 1952. I did everything that I could, Senator, to——

Senator SMATHERS. What I am trying to get at is: When you said to him that he had not followed the instructions, did he admit that he had not followed them, or did he deny that he had not followed them?

Mr. RITCHIE. He said that he followed the instructions with certain modifications, and he named 10 modifications. The word "modification" in the dictionary, I believe, is a change.

Senator SMATHERS. Did you think those modifications were basic?

Mr. RITCHIE. I not only thought it, Senator, but every battery man and scientist that I talked to on the subject thinks so. I could be wrong, you know, too; so I have checked it with a lot of people.

Senator SMATHERS. Then is it your contention that the Bureau of Standards has never conducted a test in accordance with the instructions which ordinarily come on your formula?

Mr. RITCHIE. That is my contention, Senator; yes, sir.

Senator SMATHERS. How many tests did the Bureau of Standards conduct?

Mr. RITCHIE. I believe I can't answer that. I tried to answer it one time, and then the Post Office case came up, and I read through that, and I became quite confused. I thought I knew all the tests back to the June test that the Bureau had run or claimed to have run.

The CHAIRMAN. June of what year?

Mr. RITCHIE. June of 1952. But after reading over the docket at the Post Office, they have apparently conducted some tests that I knew nothing about. Whether the Battery AD–X2 was used in those tests or not, I don't know.

Senator SMATHERS. So that you learned that they have conducted tests about which you did not know?

Mr. RITCHIE. That is true; yes, sir.

Senator SMATHERS. During those tests you do not know whether or not they followed your instructions?

Mr. RITCHIE. No, sir; I don't.

Senator SMATHERS. It might be well that they followed the instructions accurately in those tests?

Mr. RITCHIE. I have never seen a report of any of the tests that would indicate that they did.

Senator SMATHERS. Nor have you ever seen one that indicated that they did not?

Mr. RITCHIE. Yes, sir; I have seen many that indicated that they did not.

Senator SMATHERS. Well, now, just a second here. You said that apparently you learned that they had conducted some tests about which you knew nothing?

Mr. RITCHIE. Yes, sir.

Senator SMATHERS. If you knew nothing about it, then how did you see these reports that you are talking about?

Mr. RITCHIE. I didn't say that I saw those reports, I believe, Senator. I just saw the number of these batteries in this situation. What

I said was that of the tests that I have seen reported, I have not seen a test that followed my instructions, based on their report.

Senator SMATHERS. That is right. But you agree that they have conducted some tests, the reports of which you have never seen?

Mr. RITCHIE. Yes, sir. And I do not know whether those tests were conducted with Battery AD–X2 or not.

Senator SMATHERS. Then you are saying that they have conducted some tests on batteries either with or without AD–X2?

Mr. RITCHIE. I am saying I don't know.

Senator SMATHERS. All right. And you do not know whether it was with AD–X2 or, if it was with AD–X2, whether or not they followed the instructions?

Mr. RITCHIE. That is true, on those tests that I know nothing of.

Senator SMATHERS. Yes.

Mr. RITCHIE. The ones that I do know of, I know that the instructions were not carried out.

Senator SMATHERS. Let me ask you one more question, and then I will yield to somebody else. You say that you are the only one who knows how to make this formula; is that correct?

Mr. RITCHIE. That is true.

Senator SMATHERS. And when you do not make it, I presume nobody makes it?

Mr. RITCHIE. That is true.

Senator SMATHERS. Have you been selling this formula recently?

Mr. RITCHIE. Some; not a great deal.

Senator SMATHERS. When was the last batch of this formula made up?

Mr. RITCHIE. Senator, when you get into that formula, I forget everything. I don't remember. I will tell you this. I make lots of quite large quantities, because my time is involved and I make very large quantities when I make the material.

Senator SMATHERS. How much would you say you make at one time?

Mr. RITCHIE. I don't remember that.

The CHAIRMAN. Mr. Ritchie, you must remember whether you made 10 pounds or 100 pounds or a ton, or whatever you make.

Mr. RITCHIE. Senator, my weights are critical in this.

The CHAIRMAN. When you make up a complete batch of it, you must know whether you are making up 1,000 or 2,000 pounds at a time.

Mr. RITCHIE. I do.

The CHAIRMAN. I know. But I mean, when you make it up, you make up a volume in bulk, do you not?

Mr. RITCHIE. Yes, sir.

The CHAIRMAN. And then after you have made it in bulk, then you fill up the little packages and make up a carton for a battery?

Mr. RITCHIE. Yes, sir.

The CHAIRMAN. Now, you must know how many pounds you make up every time you make up a mixture of it, do you not?

Mr. RITCHIE. Yes, sir.

The CHAIRMAN. So that you could answer that question that you make 1,000 pounds at a time or 500 pounds or even, we will say, a ton at a time. We just want this record to be as intelligently composed as possible.

Mr. RITCHIE. I will make this statement, that I normally make about 6,000 pounds at a time.

The CHAIRMAN. Now you are answering the question.

Senator SMATHERS. Then you say you do this all by yourself?

Mr. RITCHIE. No. I have done it, Senator, by myself, but I haven't done it by myself recently.

Senator SMATHERS. I thought you said you were the only one who made this formula. Did you not just say that a few minutes ago?

Mr. RITCHIE. That is true.

The CHAIRMAN. Senator Smathers, might I just interrupt briefly there? Mr. Ritchie, you have what type of mixing equipment when you mix this? Is it steel rotary drums? You could not possibly pour it in such a manner that you get the right amount in there; you must take this and add whatever you add and then put it into some type of rotary to get a complete mix on it, do you not?

Mr. RITCHIE. We use equipment; yes. It is all mechanical.

The CHAIRMAN. In other words, if you are making up 1,000 pounds of this, you add so many pounds of every ingredient, and then a mechanical device is put into motion for mixing.

Mr. RITCHIE. That is true.

The CHAIRMAN. If you are adding to just an ordinary high protein dairy ration, you have to put it through a mechanical mix. You put in the proteins and then proceed to mix it so that you have a uniform content of all ingredients in that mixture to every pound.

Mr. RITCHIE. Yes, sir.

The CHAIRMAN. And that is the only way that you could mix that. It is mechanical?

Mr. RITCHIE. That is true.

The CHAIRMAN. You are not doing it with a spoon or a scoop shovel?

Mr. RITCHIE. That is true. Our equipment is all specially designed equipment. We have very little standard equipment in the plant.

The CHAIRMAN. Senator Smathers, I am sorry for the interruption.

Senator SMATHERS. I am glad to have your explanation, Mr. Chairman, which helps to clear up my question. Whereabouts do you make this formula? Do you make it in the same place every time?

Mr. RITCHIE. I do.

Senator SMATHERS. And you have a room where you can make 6,000 pounds of it?

Mr. RITCHIE. I do. I might answer that it is more than one room. But it is a plant where I make 6,000 pounds of it.

Senator SMATHERS. And you store it in this same plant?

Mr. RITCHIE. After it is finished, no. It is moved.

Senator SMATHERS. And nobody else knows this formula but you?

Mr. RITCHIE. That is true. As I said yesterday, my vice president knows the mechanics.

Senator SMATHERS. That is all the questions I have to ask right now.

The CHAIRMAN. Senator Ferguson?

One member has returned on the right here, gentlemen. That is why I was turning to Senator Ferguson.

Senator FERGUSON. Mr. Ritchie, I want to get at what your real complaint is here. Is it that there is a fraud order prohibiting you from using the mails?

Mr. RITCHIE. That is the final claim. The fraud order is suspended at this time, which allows us to use the mail, but the blemish of operating under a suspended fraud order, Senator Ferguson, is something like operating on parole.

Senator FERGUSON. I noticed on your board yesterday you had a very high peak of production. You marked it "mail fraud" at the top of it, and then the next production is very low, going back to about where it was in 1948, as I look at that chart. Did the fraud order practically put you out of business?

Mr. RITCHIE. Yes, sir; the fraud order, even though it is suspended, has cost us about $1,000 a week ever since it started.

Senator FERGUSON. It practically put you out of business, then?

Mr. RITCHIE. It has for all practical purposes.

Senator FERGUSON. What was the peak of your production? What was the peak of your sales in dollars?

Mr. RITCHIE. In the first and second quarters of 1951 we were selling per quarter somewhat better than $60,000 and somewhat less than $80,000.

Senator FERGUSON. What?

Mr. RITCHIE. Of material.

Senator FERGUSON. How long a period?

Mr. RITCHIE. That was a 6-month period.

Senator FERGUSON. $80,000 in 6 months?

Mr. RITCHIE. It ran better than that, I believe, Senator. It would be about $130,000 or $140,000.

Senator FERGUSON. About $130,000 or $140,000 in 6 months?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON. Now what has been your production since the fraud order?

Mr. RITCHIE. I think our sales last month were about $4,000.

Senator FERGUSON. About $4,000?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON. Now do I understand that the fraud order is merely suspended?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON. And it might go into effect any day?

Mr. RITCHIE. It can go into effect with the scratch of a pen.

Senator FERGUSON. Now, what were you charged with in this fraud order? With the use of the mails to defraud the public?

Mr. RITCHIE. The use of the mails, yes, sir, to defraud.

Senator FERGUSON. All right. Now yesterday I asked you the question, and I wondered whether or not you could explain as to whether or not any of the public, as far as you know, has ever made a complaint.

Mr. RITCHIE. No, sir; we have no record, and we can find no record of a consumer complaint against Battery AD–X2.

Senator FERGUSON. I understand that in the post office the idea of a fraud order is to protect the general public. It is in behalf of the general public. But you say, now, that no general public or no individual has ever made a complaint that you were using the mails to defraud them; is that right?

Mr. RITCHIE. I have no information that there has ever been a complaint by a user of Battery AD–X2 to anyone, Post Office, Federal Trade Commission, National Better Business Bureau, Oakland Better Business Bureau, San Francisco Better Business Bureau. Sen-

ator, we have no complaint by a user of AD–X2 to anyone. I think the Bureau of Standards said last summer that they had never had a complaint.

Senator FERGUSON. And, as I understand it, did the Bureau of Standards make the complaint for the Post Office to get the fraud order?

Mr. RITCHIE. We have no information on that, Senator, except rumor. We understand that the liaison man between the Bureau of Standards and the Post Office Department was the man who made the complaint. Now, we have no proof of that.

Senator FERGUSON. Then that would indicate that the liaison officer between the Bureau of Standards and the Post Office—that would indicate that the Bureau of Standards, in effect, was enforcing its will by virtue of the fraud order. Is that what you say is true now?

Mr. RITCHIE. Yes, sir. It goes a bit further than that, I believe, Senator. The Bureau of Standards has been condemning this material directly through the National Better Business Bureau and through their own publications, not going through the Federal Trade Commission or going through the Post Office Department, but directly. They have been doing that to us for years.

Senator FERGUSON. Do you know of any other cases where the Bureau of Standards has cooperated with a Better Business Bureau in the way that they have here, in the criticism of your material?

Mr. RITCHIE. I have no personal knowledge. My mail discloses a number of very strange things along that line, Senator. I have never known my mail to disclose such a situation as this one is here. Of course, you can't tell how reliable these things are, but I get an awful lot of mail about people complaining about bad tests. I heard of one just the other day by a Better Business Bureau up in Detroit, I believe it is. They are practically—well, they have stopped the man's advertising up there, through actions on a product that looks as though it might be this type of thing. As I say, I know nothing of his product, but I do know that they have taken action to stop his advertising.

Senator FERGUSON. Now, you live in Oakland, Calif.?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON. You have a Better Business Bureau there?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON. Has that Better Business Bureau ever gone into court to try to restrain you from your advertising on the use of the mails or anything else?

Mr. RITCHIE. No, sir, Senator. On the contrary, we have always cleared all of our advertising with them right from the beginning. We are members of the Oakland Better Business Bureau, and we have always cleared our advertising right from the beginning with the Oakland Better Business Bureau, and invariably sent copies of it to the Federal Trade Commission, to the San Francisco Better Business Bureau, and the National Better Business Bureau.

Senator FERGUSON. Are you in good standing with the Oakland Bureau?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON. Now, how is it connected with San Francisco? It is right across the bay. But is it part of the San Francisco Better Business Bureau?

Mr. RITCHIE. No, sir; it isn't. There are two separate organizations.

Senator FERGUSON. Two separate organizations. Well, has the San Francisco one ever tried to restrain you from operating?

Mr. RITCHIE. No, sir; on the contrary, they have written letters to the National Better Business Bureau explaining to them that they have investigated us and that we are honorable people.

Senator FERGUSON. Then, do I understand that both the Oakland Better Business Bureau—that is your home town?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON (continuing). And San Francisco, which is adjacent, have no complaints and make no complaints that you are trying to defraud the public?

Mr. RITCHIE. That is true, Senator. They have never had a complaint.

Senator FERGUSON. Then we move to Philadelphia, where the National Better Business Bureau is. Have they ever made any complaints that you were trying to defraud the public?

Mr. RITCHIE. The National Better Business Bureau is in the Chrysler Building in New York.

Senator FERGUSON. I thought it was in Philadelphia. Change my question, then, to be in New York.

Mr. RITCHIE. They, by their own report, as of last December, I believe it was—and I have talked to them more recently—have never had a complaint against Pioneers, Inc., by a consumer of the product. They have condemned the product by implication and by quoting from the National Bureau of Standards.

The CHAIRMAN. You mean the Better Business Bureau was quoting from the pamphlet of the Bureau of Standards?

Mr. RITCHIE. Pamphlets and letters from the National Bureau of Standards, in condemning our product.

Senator FERGUSON. But not from customers or users?

Mr. RITCHIE. No, sir.

Senator FERGUSON. In other words, the National Better Business Bureau has taken a test from a laboratory, being the National Bureau of Standards, and used that in criticism of your product, but they do not use any from users or consumers?

Mr. RITCHIE. No, sir; they do not. And they have done that over the protest of our own Better Business Bureau, repeatedly, under three different managers.

Senator FERGUSON. When was this fraud order issued by the Post Office?

Mr. RITCHIE. I don't have my notes here. I believe it was the 26th of February.

Senator FERGUSON. The 26th of February of this year?

Mr. RITCHIE. Yes, sir. And it was lifted on March 2. I will never forget that.

Senator FERGUSON. But you feel now that with the order in existence that is suspended, it has practically wrecked your business?

Mr. RITCHIE. It has; yes, sir. I have been here ever since trying to do something about it.

Senator FERGUSON. Have you a counsel in that case?

Mr. RITCHIE. Yes, I do.

Senator FERGUSON. When do they expect to try that case to determine whether or not the order will be final?

Mr. RITCHIE. We had some correspondence with them recently through counsel, and they said, I believe, that they had no intentions of doing anything about the fraud order until after the Kelly committee had reported on its test of Battery AD–X2. As I understand it, the Kelly committee and the Bronk committee and those committees are not set up to test Battery AD–X2, but are set up to evaluate the work of the Bureau of Standards, and one committee to evaluate the work of the Bureau of Standards on battery additives, including Battery AD–X2, both laboratory work and field tests. And, incidentally, I know of no field tests that the National Bureau of Standards themselves have ever run on Battery AD–X2.

Senator FERGUSON. Mr. Chairman, I wondered whether or not the committee was going to have as a witness the Post Office Department and those in charge of issuing this fraud order, so that we may go into the details of how this was procured and upon what grounds they based their fraud order. I can see that the witness does not know that.

The CHAIRMAN. The Post Office Department will be called on. Various military personnel who had anything to do with the AD–X2 in their normal operations will be called on. We are going to try to develop an absolute and factual report on this. So I assure you that every one concerned will be called on.

Mr. RITCHIE. Thank you, sir.

Senator FERGUSON. In the Post Office fraud order, do they mention what the fraud is?

Mr. RITCHIE. They say that this material is worthless. I cannot quote it word for word. The strange thing about the order was that they quoted our claims out of context, so that it would take me about 3 days to figure what they are talking about. They claimed that we were selling something to the public that was absolutely valueless, and using the mails to sell it.

Senator FERGUSON. Had you had a test by MIT on this prior to this fraud order?

Mr. RITCHIE. No, sir. The fraud order was issued—the fraud-order hearing was held on October 13. Yes, the MIT test was made available to the Post Office about 2 or 3 weeks prior to the issuance of the fraud order itself. But in their action, they said of the MIT test that it would be very difficult to find a poorer excuse for a scientific test.

The CHAIRMAN. Senator Ferguson, if I might interrupt at this point, Mr. Ritchie never asked MIT for a test on this product.

Mr. RITCHIE. No, sir.

The CHAIRMAN. That test was instigated by the Small Business Committee.

Mr. RITCHIE. Yes, sir, by Senator Sparkman.

The CHAIRMAN. And it was initiated by Mr. O'Connor last fall, when Senator Sparkman was chairman of the committee.

Mr. RITCHIE. Yes, sir.

The CHAIRMAN. Mr. O'Connor, I believe, was the gentleman who initiated the MIT investigation of it.

Mr. RITCHIE. With the assistance of Mr. Annis, I believe.

Senator FERGUSON. Thank you for straightening that out.

But now, you mentioned the date last October about the Post Office. Were they considering issuing this as early as last October?

Mr. RITCHIE. Yes, sir. They held a hearing on October 13 at which we defaulted, because, through a misunderstanding, we thought that there was going to be no hearing until after the MIT work was completed. And they held the hearing, and we were, of course, guilty by default. And we immediately, upon finding out about this, upon finding out that such a thing could be done, filed for a correction of default, and we didn't hear anything from that. So then at a later date, we filed for a reopening of the case to accept the MIT test in evidence, together with a test from, I believe it was, the United States Testing Co. And we never heard from that until the Solicitor wrote an answer to it, and when he wrote this answer to it, he recommended that the case not be opened. So then our attorneys in Oakland once again wrote and asked that the case be reopened, and then the next thing we heard about it was when we got the fraud order, effective immediately. In the fraud order they threw out the action for correction of default, the application to reopen the case the second time, and made the fraud order applicable immediately. In other words, they stopped our mail right that day.

Senator FERGUSON. As I understand it, now, in October you had a chance to appear, and because of a conflict in dates or something, you did not appear. Did you ever appear and give testimony?

Mr. RITCHIE. No, sir.

Senator FERGUSON. Did you file this MIT test that was made for the Small Business Committee?

Mr. RITCHIE. I did; yes, sir.

Senator FERGUSON. And you say you filed as part of your request for a rehearing or reconsideration a private United States——

Mr. RITCHIE. I am not sure about that, Senator, and I don't have my notes here. I do know that the MIT test was the thing that we filed. That I know. There might have been some supplementary material. There was. But I can't recall exactly what it was. But the MIT test was the thing that we thought would cause them to reopen the case and hear our evidence.

Senator FERGUSON. But instead of reopening it, on February 25 they issued a fraud order?

Mr. RITCHIE. Yes, sir, not only against Pioneers, Inc., but against all of the officers. And the strange part of it was that the officers of Pioneers, Inc., hadn't drawn any pay from the outfit for pretty nearly a year at that time.

Senator FERGUSON. All right. But they had a copy of the MIT investigation as far as this Small Business Committee was concerned?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON. And they denied your rehearing and reconsideration and issued the fraud order?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON. Now, will you tell us what happened between that and the second of March when the fraud order was set aside or stayed?

Mr. RITCHIE. The first thing that happened, we got hold of the Senate Small Business Committee. The next thing that happened, we got hold of our attorney, and the attorney wrote up about a 3-page document to the Postmaster General, in which he pointed out that

by no stretch of the imagination, in his opinion, could there be an intent to defraud. And the next thing, Senator Thye wrote a letter of transmittal to the Postmaster General, and Mr. O'Connor of the Small Business Committee's staff delivered that personally to Mr. Summerfield at his apartment out on Connecticut Avenue.

Then there was a meeting called on Monday morning, March 2, and the Secretary of Commerce requested that the Post Office Department take some action so that we could get our mail, so that it would not be returned marked "Fraud."

The Attorney General advised the Postmaster General that he could legally suspend the order, and he did.

Senator FERGUSON. Can you do business without the United States mail?

Mr. RITCHIE. I believe you can't; no, sir.

Senator FERGUSON. You cannot?

Mr. RITCHIE. I believe you can't. We don't do any mail-order business, but——

Senator FERGUSON. No. But do you have——

Mr. RITCHIE. But the very fact that you are in trouble with the Post Office, Senator, eliminates you from the business world. And that has been my experience in this case.

The CHAIRMAN. Therefore, the answer to Senator Ferguson is that with the fraudulent order over you, so that you cannot use the mail, you cannot do business?

Mr. RITCHIE. With the fraudulent order over you, even though you can use the mails, you are out of business.

The CHAIRMAN. I know. But——

Mr. RITCHIE. With the fraud order, you can't do anything.

The CHAIRMAN. If the fraudulent order had stood, you would have had to close your doors, because you could not have done any business?

Mr. RITCHIE. You could not operate; no, sir.

The CHAIRMAN. You cannot operate without the mails?

Mr. RITCHIE. You cannot operate without the mails.

The CHAIRMAN. Because you cannot receive an order and cannot transmit a reply?

Mr. RITCHIE. You cannot get a letter or transmit a reply. And the vicious thing about those orders is, they don't stop you from sending mail out. You can go ahead and send out all the mail you want to. But all the mail that comes in to you is stamped "Fraud" and returned by——

Senator FERGUSON. Returned to the sender?

Mr. RITCHIE. Returned to the sender. My Lions Club, my Better Business Bureau, my wife's lodge papers, and everything, when we got them. Then they went back, because some attorney out there, whom I don't know, some United States attorney, called the postmaster at Oakland and asked him to hold the mail. He did. And so we got all of our mail. It came to us. But every piece of it was stamped "Fraud." I've got an envelope full of it here now.

Senator FERGUSON. Then you had a fraud order issued against you where you had made a petition to set aside a default?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON. And you wanted to be heard?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON. And you filed a report from the committee of the Senate that had been made by MIT.

Mr. RITCHIE. Yes, sir.

Senator FERGUSON (continuing). And you then filed another report, and the Post Office authorities would not give you a rehearing, but issued the order?

Mr. RITCHIE. They disregarded three instruments: a correction for default; an application to reopen the case and receive the MIT test; and a second application to reopen the case and hear our evidence. When they put the order into effect, they overruled all three of our instruments requesting them to reopen the case and hear our evidence.

Senator FERGUSON. Now, what was your reason for not appearing in October?

Mr. RITCHIE. As I understood the situation, where there is a technical controversy, it is not the position of the Postmaster General to settle such a controversy. His function under the law is to issue a fraud order if a person is willfully defrauding. In other words, if he has intent to defraud someone or if it is something that is in the public interest, where property, health, and the pursuit of happiness are involved, and it is being done intentionally, he issues a fraud order. So, at these meetings on September 29, at which officers from the Post Office Department were present, they couldn't help but know that there was, at the best, a technical argument, a discussion, and that we had respectable opinion on our side.

So I became very friendly with the Assistant Solicitor who was handling the case. I discussed it with him at great length, and I went over and paid him a visit personally. That was an error if I ever made one in my life, because during the discussion, I made the statement that since I couldn't subpena witnesses, and my witnesses were all over the country, it seemed to me like I would be a wise man to let the thing go by the board and try it in court where I could subpena witnesses.

Well, I am not an attorney, but I have found out that that was a very stupid statement for anyone to make. He had taken it that I had said that I had no intentions of attending the hearing, and was going to let it go by default.

That wasn't the case at all, because when he explained to me that if I let it go by default and did not exhaust my rights under the Administrative Procedure Act, that I couldn't get a court hearing, why, I could see the point.

So then the next thing was getting the MIT test ready.

Senator FERGUSON. Did you have a lawyer at that time?

Mr. RITCHIE. No, sir. I kept a lawyer all summer——

Senator FERGUSON. You are negotiating with the Solicitor and had gone to his home?

Mr. RITCHIE. No. I went to his office at the Post Office Building.

Senator FERGUSON. Well, his office.

Mr. RITCHIE. We got very well acquainted during the discussion, or fairly well acquainted. I went to his office. I didn't have counsel, because I had let the counsel go back in August, I believe it was, because I had run out of the stuff that you pay them with.

Senator FERGUSON. You could not use this additive?

Mr. RITCHIE. No, I couldn't barter with him.

Senator FERGUSON. Now, did the Solicitor know that you did not have counsel and that you were negotiating with him personally on this matter?

Mr. RITCHIE. Yes; he knew that. In fact, that is why he advised me on this Administrative Procedure Act. He knew I was without counsel, and he very accommodatingly advised me. He further tried to get me to sign a slip of paper on which I said I wouldn't do any mail-order business. Well, I don't do but about 1 percent of mail-order business, and that costs us money. And he said if I signed that, we would forget the whole thing, because all they wanted to do was to get out of the thing.

So I told him that while the mail-order business didn't mean anything to us, I felt there was a principle involved, and I preferred to die with my principle rather than with money. So I wouldn't sign it.

Senator FERGUSON. Now, at that time, was MIT investigating this thing?

Mr. RITCHIE. MIT was making preparations to run the test at that time.

Senator FERGUSON. Did you tell him that?

Mr. RITCHIE. I discussed it with him; yes.

Senator FERGUSON. That the Small Business Committee was looking into the matter?

Mr. RITCHIE. Yes, sir.

Senator FERGUSON. And was going to get a test?

Mr. RITCHIE. And he said that he didn't understand it that way, that he thought that when we finished the meeting at the Bureau of Standards on the 29th of September, that nothing had been decided, that there wasn't going to be any test.

I thought he was mistaken on that, because the Senate Small Business Committee was working on it, and MIT was working on it, and I was getting ready at that time to start rustling batteries for them. That was my only part in the program, to rustle the batteries.

Senator FERGUSON. That is all.

The CHAIRMAN. Senator Sparkman?

You pass, Senator Sparkman?

Senator SPARKMAN. Yes.

The CHAIRMAN. Senator Humphrey?

Senator HUMPHREY. Mr. Ritchie, going back to some of the questioning by Senator Smathers, is Protecto-Charge the same thing as AD–X2?

Mr. RITCHIE. Yes and no.

Senator HUMPHREY. Would you explain that?

Mr. RITCHIE. Yes, sir. Protecto-Charge originally was not the same as Battery AD–X2. We kept the name Protecto-Charge because we had difficulty with it through a prior association of mine, and we didn't want to drop the name because I felt people might feel that I was trying to drop my obligations. So we kept the name after we had developed Battery AD–X2, and perfected it, up until about mid-1948, when the Atlas Distributing Co., which is the sales branch of the Standard Oil Co., put out a trickle charger, which they called Protecto-Charge, and they claimed prior rights to the name, and we had no particular pride in the name, and we got ourselves

pretty well straightened up by that time. So we dropped the name and adopted the name of Battery AD–X2.

Senator HUMPHREY. Are the chemical formulas the same?

Mr. RITCHIE. No, sir.

Senator HUMPHREY. They are different?

Mr. RITCHIE. Yes, sir.

Senator HUMPHREY. When would you say——

Mr. RITCHIE. Now, let me correct that, Senator. The chemical formulas are different as of October 1947.

Senator HUMPHREY. As of October?

Mr. RITCHIE. They are all different as of from June of 1947 to October of 1947.

Senator HUMPHREY. Yes.

Mr. RITCHIE. And then they were different back of June 1947. That is where we had the difficulty, between the first of 1947 and June of 1947.

Senator HUMPHREY. I see. When would you say that you came across the formula that you are now using? In your article—one of the newsmen here was kind enough to give me a copy of the magazine for July entitled, "Cars," which has a very fine feature story concerning your activities and your product. In that article, I think it says something like this:

> We added minute traces of other chemicals to our mixtures and from April to October 1947 I often worked all night. We ran through more than 1,600 different chemical blends.

So my question is, When did you hit upon this AD–X2 formula?

Mr. RITCHIE. In October.

Senator HUMPHREY. In 19—?

Mr. RITCHIE. In 1947.

Senator HUMPHREY. 1947?

Mr. RITCHIE. Yes, sir. The formula has not been changed since October 1947.

Senator HUMPHREY. Do you recall that on July 8, 1948, Dr. Randall wrote to the Bureau of Standards saying, and I just quote from his letter which I think you introduced into the evidence here:

> Over 85 percent of these batteries responded to treatment—

he was speaking now of the batteries which used the AD–X2; is that not correct?

Mr. RITCHIE. Yes, sir.

Senator HUMPHREY. He says:

> Over 85 percent of these batteries responded to treatment and have remained in service without a single failure, some of them for as long as 17 months.

Now, that letter was written on July 8, 1948. So would it not appear that the material which you are now selling and manufacturing was being used as early as December of 1946 or January of 1947?

Mr. RITCHIE. 1947 I believe would be right. When we got the second additive, we went back over a number of those batteries and treated them. The trouble we were having was shedding, in the original formula. In the second formula, we didn't have the shedding, but we lowered the hydrometer reading. And then when we developed AD–X2, we went back to some of these batteries and treated them for the third time.

Senator HUMPHREY. Was not Dr. Randall writing about AD–X2 in his letter of July 8, 1948?

Mr. RITCHIE. No, sir. He would have been writing about "Protecto-Charge No. 2," which was AD–X2.

Senator HUMPHREY. He was writing about "Protecto-Charge No. 2"?

Mr. RITCHIE. Right.

Senator HUMPHREY. So that his communications with the Bureau of Standards are not communications, then, that referred to AD–X2 at all?

Mr. RITCHIE. This was in July 1948, you say?

Senator HUMPHREY. Yes.

Mr. RITCHIE. No. I was thinking back in 1947, Senator. All of Dr. Randall's correspondence—you see, this was developed in October of 1947, and Dr. Randall's first letter to the National Bureau of Standards was on May 23, 1948.

Senator HUMPHREY. There was also one on July 8, 1948.

Mr. RITCHIE. Yes. That would have been on Battery AD–X2, too, then known as Protecto-Charge.

Senator HUMPHREY. Then Dr. Randall says in that letter that 85 percent of these batteries responded to treatment and have remained in service without a single failure, some of them for as long as 17 months.

My question is very simple. If his letter referred to AD–X2, and you say that AD–X2 was discovered in October of 1947, and yet here is a letter dated July 8, 1948, that refers to 17 months of service of rejuvenated batteries, how do you put those things together when the discovery was made in October 1947, and 17 months back from the July letter, 1948, takes you into December or January, 1946–47?

Mr. RITCHIE. I was in the Philippine Islands in 1946.

Senator HUMPHREY. I appreciate your travels, but what I am asking is: If Dr. Randall says—and this is what he said—that these batteries have remained in service without a single failure, some of them for as long as 17 months, and he is writing about AD–X2 on July 8, 1948, according to your testimony, and yet you say you discovered AD–X2 in October of 1947, 17 months back from July 1947, takes you back to either December of 1946 or January of 1947, before the discovery.

Mr. RITCHIE. Then I would say that Dr. Randall's date of the—what is the date given there? Seventeen months?

Senator HUMPHREY. Seventeen months.

Mr. RITCHIE. I would say the figure was probably in error.

Senator HUMPHREY. Would you say that Dr. Randall was wrong on the number of months?

Mr. RITCHIE. I wouldn't say that he was wrong, necessarily. He could be wrong. I would say that the figure is in error. I rather think it was typographical error, myself. That would be a guess.

Senator HUMPHREY. Do you have a patent on AD–X2?

Mr. RITCHIE. I think I told you, Senator, yesterday, that I did not.

Senator HUMPHREY. You do not have a patent?

Mr. RITCHIE. No, sir.

Senator HUMPHREY. You have some patent rights to the old "Protecto-Charge" formula?

Mr. RITCHIE. I do not.

Senator HUMPHREY. Did you attempt to buy some equity in those patent rights?

Mr. RITCHIE. I bought them.

Senator HUMPHREY. You bought them?

Mr. RITCHIE. Yes.

Senator HUMPHREY. Did you release them?

Mr. RITCHIE. I let it drop.

Senator HUMPHREY. You let them drop?

Mr. RITCHIE. Yes.

Senator HUMPHREY. Now, I was interested in Senator Smathers' queston, and I believe Senator Thye helped clarify the situation in reference to the amount of this product that you prepare. As I understood, you were doing this in rough terms, and therefore I do not hold you to the accuracy of the terms. You said around 6 tons at a time?

Mr. RITCHIE. Around 6,000 pounds, I believe.

Senator HUMPHREY. 6,000 what? 6,000 pounds?

Mr. RITCHIE. Right.

Senator HUMPHREY. That is about——

The CHAIRMAN. Three tons.

Senator HUMPHREY. Three tons; right?

Mr. RITCHIE. Yes.

Senator HUMPHREY. Let me ask you, Do you have a bill of sale as to the materials that you used? Did you present that to the committee?

Mr. RITCHIE. No, sir. I destroy those as I get them.

Senator HUMPHREY. How do you buy magnesium sulfate and sodium sulfate, and from whom do you buy it? What chemical house?

Mr. RITCHIE. I don't care to divulge that.

Senator HUMPHREY. It is a very common item. It is a standard formula, is it not?

Mr. RITCHIE. I never said that it was.

Senator HUMPHREY. You do not need to say that it was. I mean, magnesium sulfate is a very standard formula, is it not? Mg SO_4; is that not right? Magnesium sulfate? Is it not one of the commonly known drugs or chemicals?

Mr. RITCHIE. As I explained yesterday, I am not a druggist.

Senator HUMPHREY. Well, let us not worry about that. You mix the products, do you not?

Mr. RITCHIE. I do.

Senator HUMPHREY. You must know what you are mixing.

Mr. RITCHIE. I wouldn't say that.

Senator HUMPHREY. You would not? My question is——

The CHAIRMAN. Senator Humphrey, if you please?

Senator HUMPHREY. Yes.

The CHAIRMAN. Mr. Ritchie, you do not want the record to stand in this form, that you do not know what you are mixing?

Mr. RITCHIE. I know what I buy, Senator, and I know that I buy the same material each time and that the material is specified to me as containing such and such things, and that I use these same materials each time, use them under the same conditions, give them the same processing, and using the same weights.

The CHAIRMAN. Then your answer should have been that you definitely know what you are mixing, Mr. Ritchie, because this is very, very important. You mean that you are mixing certain ingredients,

and that you know the quantity of each of the ingredients that you mix. You have to do that.

Mr. RITCHIE. Yes.

The CHAIRMAN. Otherwise you would not have a uniform and a consistent product.

Mr. RITCHIE. I buy these chemicals to a specification.

The CHAIRMAN. Yes. Your answer must be that you know what you are mixing, because if your answer is not that, then your testimony does not have meaning.

Mr. RITCHIE. Then I will put it this way, Senator. I know what I am mixing. I know what I buy.

The CHAIRMAN. Yes.

Mr. RITCHIE. I know what I put in. I know the amount. I know the process that I give it.

The CHAIRMAN. Well, that would be——

Mr. RITCHIE. But the only protection on the face of the earth that I have for this formula is by keeping these things to myself, and I fully intend to do it.

The CHAIRMAN. I know. But your answer would be a perfectly reasonable answer if you answered Senator Humphrey that you knew the quantities and the kind of products that you mix, and that you must have a formula, and that formula must be uniform or otherwise your product would not be uniform.

Mr. RITCHIE. That is true, Senator. But even the people working in my plant don't know where the material comes from.

Senator HUMPHREY. Oh, well——

The CHAIRMAN. That was not the question.

Senator HUMPHREY. Mr. Chairman——

The CHAIRMAN. Where the material came from was not the Senator's question. The Senator's question was as to the volume mixed and as to the amounts mixed, and on that question, it would seem very strange to me if you did not know the volume that you mixed. I just wanted to get that clear in my own mind.

Mr. RITCHIE. Yes, sir. That I do. The thing that I was attempting to avoid was giving any information that might disclose anything concerning the formula.

Senator HUMPHREY. Now, I am not going to ask you about the formula, because you have said before that you did not really know it. In a sense, it was discovered by accident; is that correct?

Mr. RITCHIE. That is true; yes.

Senator HUMPHREY. All right. There is no secret about magnesium sulfate. You cannot have a chemical labeled magnesium sulfate unless it is the same no matter where you buy it from. It is just like aspirin. Wherever you buy it, it is aspirin. There is no difference whatsoever, is there?

Mr. RITCHIE. Isn't there different grades?

Senator HUMPHREY. There is none whatsoever. It is aspirin, and so labeled; it is exactly the same chemical test. And the same thing is true, is it not, of magnesium sulfate?

Mr. RITCHIE. I know we always specify USP.

Senator HUMPHREY. That is the only kind you can get, U. S. Pharmacopoeia, which I have right before me. That is why I am asking you the question. Now, if you buy magnesium sulfate or sodium sulfate, you have to get the same kind of product, do you not,

and it has to assay out the same way, every bit of it, does it not? If you are in this business of mixing chemicals——

Mr. RITCHIE. I would say "Yes."

Senator HUMPHREY. All right. Now, let me ask you, then, where do you buy your magnesium sulfate?

Mr. RITCHIE. No one knows where I buy my magnesium sulfate, and I don't believe that I am justified in disclosing where I buy it.

Senator HUMPHREY. All right. I will not insist at the moment. However, may I say that this is just about as big a secret as a calendar, you know? I mean, magnesium sulfate is as common as table salt.

Mr. RITCHIE. When you are working with something and things are critical with you, with weights, et cetera, you do not broadcast.

Senator HUMPHREY. All right. Let me ask you what kind of containers do you buy your magnesium sulfate in? Does it come in cartons, barrels, drums, or bags?

Mr. RITCHIE. I would rather not answer that question.

Senator HUMPHREY. I think that it is very important that you answer it.

Mr. RITCHIE. I cannot see where it would have any bearing on the case, myself.

Senator HUMPHREY. I think it would have a great deal of importance.

Mr. RITCHIE. Mr. Chairman——

Senator HUMPHREY. Do you buy it in a paper carton or a steel drum? Is it sealed, or is it in a bag open to air?

Mr. RITCHIE. Mr. Chairman, I prefer not to answer that question.

Senator HUMPHREY. Let me ask it a different way, Mr. Chairman.

The CHAIRMAN. You may ask it in a different way. I would say that I believe that it is agreed to by you and the witness that the compound is identical no matter where you buy it.

Senator HUMPHREY. That is correct.

The CHAIRMAN. Whether you buy it from one wholesale house or another, it is all the same.

Senator HUMPHREY. It is all the same.

The CHAIRMAN. Therefore, it makes no difference where he buys it?

Senator HUMPHREY. No.

The CHAIRMAN. Because it is the same product wherever he buys it, whatever kind of package it comes in.

Senator HUMPHREY. That is very important.

The CHAIRMAN. I think it is immaterial.

Senator HUMPHREY. No. That is very important. The reason that I ask this question is that I want to know in what kind of a container it comes because the salts that you are using are either capable of taking on water or losing water, depending on the condition in which you buy them. If you buy them as an anhydrous salt, they are dry salts. But if you buy them as normal magnesium sulfate, they are what you call wet salts.

Now, let me ask you, the product which was referred to by Dr. Randall he said was anhydrous sodium sulfate and magnesium sulfate, which means a dry salt; is that correct?

Mr. RITCHIE. I believe that statement is correct; yes.

Senator HUMPHREY. All right. Now, do you have any kind of protection? First of all, as I understand it, you weigh out this material, do you not, when you make it? When you make a formula, you

have to weigh it out? As Senator Thye pointed out, you carefully weigh it so that you get the proper amount of ingredients; is that correct?

Mr. RITCHIE. I weigh it, yes.

Senator HUMPHREY. Are you careful in your weighing?

Mr. RITCHIE. Yes.

Senator HUMPHREY. Would a salt without water weigh more than a salt with water, or would it weigh less?

Mr. RITCHIE. I don't know the answer to that question.

Senator HUMPHREY. Well, the reason I asked the question is, very simply put, that both of these salts are about 50 percent water, and if they are kept in dry conditions, they lose water. If they are kept in humid conditions, they gain water. Therefore, it would affect the weight, would it not?

Mr. RITCHIE. I know with sand that——

Senator HUMPHREY. This is not sand. Sand is not absorbent in this instance.

Mr. RITCHIE. I know something about sand, and I don't know about water in the salts.

Senator HUMPHREY. Are you mixing sand?

Mr. RITCHIE. No.

Senator HUMPHREY. Or are you mixing salts?

Mr. RITCHIE. I am mixing salts.

Senator HUMPHREY. Salts. The other day you said, I believe yesterday, that you added seven trace elements; is that correct?

Mr. RITCHIE. No, sir; I didn't say that. I didn't say seven trace elements. I said that the material contains——

Senator HUMPHREY. Contains seven trace elements.

Mr. RITCHIE. Contains seven trace elements.

Senator HUMPHREY. Do you add any elements?

Mr. RITCHIE. I would rather not answer that question.

Senator HUMPHREY. You would rather not answer whether or not you use an anhydrous salt or a hydrated salt; is that correct?

Mr. RITCHIE. I prefer not to answer that; yes, sir.

Senator HUMPHREY. Possibly this is one of the reasons that there is some trouble with the Bureau of Standards.

I would like to ask you a question or two since I cannot get any information on very simple questions—I would like to ask you a question about your tests before the Bureau of Standards. Now, let me make it clear. As far as I am concerned, if you have something that makes a battery work better, I am all for you, because we all have to buy batteries, and mine is down now. I may make a deal with you right afterward, and we will try it out in my battery.

Mr. RITCHIE. I would recommend it, Senator.

Senator HUMPHREY. I understand that you did, according to Senator Smathers' interrogation—what was that? In the month of June 1952?

Senator SMATHERS. Yes; June 1952.

Senator HUMPHREY. Was it not May or June of 1952 that there was a test at the National Bureau of Standards?

Mr. RITCHIE. The test was started in June and reported on July 11, I believe.

Senator HUMPHREY. It was started in June?

Mr. RITCHIE. Yes, sir.

Senator HUMPHREY. Were you present to examine the batteries that were used in that test?

Mr. RITCHIE. I examined the batteries prior to starting the tests; yes, sir.

Senator HUMPHREY. Are you saying by that that they may have switched batteries on you during the test?

Mr. RITCHIE. No; I am not.

Senator HUMPHREY. Did they use the same batteries that you examined?

Mr. RITCHIE. I believe they did; yes.

Senator HUMPHREY. Did you give your O. K. to those batteries?

Mr. RITCHIE. I did; yes.

Senator HUMPHREY. Did a man by the name of Mr. Harrell—I believe that is his name—represent you in any of these tests?

Mr. RITCHIE. Yes; he did.

Senator HUMPHREY. Did a man by the name of Mr. Guelette represent you in these tests?

Mr. RITCHIE. Yes; he did.

Senator HUMPHREY. Were these men present at any of these tests?

Mr. RITCHIE. Mr. Harrell was present at a latter portion of the test on the inspection of the plates. Mr. Guelette was present during the running of the tests. But Mr. Guelette was not allowed to take any data or notes of any kind during the running of the test. So his presence there added or detracted very little to the tests.

Senator HUMPHREY. I want to ask this question. You claimed that the softness of the plate has a great deal to do with the battery condition; is that correct?

Mr. RITCHIE. Under some conditions, yes. A plate can be too soft, it can be too hard. You want it to remain in the wanted condition.

Senator HUMPHREY. After these tests, were you able to tell the difference between the softness of the treated and untreated plates?

Mr. RITCHIE. I was not.

Senator HUMPHREY. Despite the fact that your AD–X2 is supposed to have some effect upon that?

Mr. RITCHIE. That is right.

Senator HUMPHREY. In other words, after the tests had been run by the National Bureau of Standards, you were not able to tell the difference between the treated and nontreated plates; is that true?

Mr. RITCHIE. That is true.

Senator HUMPHREY. Would you expect under what you might call tests that were operated under your supervision, to be able to make that differentiation?

Mr. RITCHIE. I wouldn't call them "operated under my supervision," No. 1; and No. 2, I wouldn't expect anything except what we got at the Bureau of Standards under the conditions that the test was run.

Senator HUMPHREY. I am asking, if you could have set the conditions for the running of the tests——

Mr. RITCHIE. I could have taken those batteries and given them normal battery procedure, which is specified in my specifications, and showed a difference as to water losses, temperature differences, and hydrometer readings, and voltage. But it couldn't be done under the conditions that the test was run at the National Bureau of Standards.

Senator HUMPHREY. Going back once more to see if we can have any more progress on it, I understand that you are the sole mixer of the chemicals?

Mr. RITCHIE. I am the only man who knows the formula complete, the ingredients and the formula.

Senator HUMPHREY. And yet, despite your intimate knowledge of the formula, you are testifying here that you do not know very much about the respective chemicals that go into it; is that your testimony?

Mr. RITCHIE. That is true. I am not a chemist.

Senator HUMPHREY. You are not a chemist?

Mr. RITCHIE. No, sir.

Senator HUMPHREY. You are unable to tell this committee—am I correctly informed—as to whether or not you are using a dry salt which would have much more potency or a normal hydrated salt, which would have less potency; is that correct?

Mr. RITCHIE. I am unwilling to tell the Senators what I am using. I can tell the Senators that I know what I am using, but I am unwilling to tell the Senator what I am using.

Senator HUMPHREY. Would you think that temperature control and humidity control would have any effect upon the quality of your product?

Mr. RITCHIE. Those things have effects upon most everything.

Senator HUMPHREY. Do you have temperature control in your factory and humidity control in your storehouse for the basic chemicals?

Mr. RITCHIE. The end of the package says "Store in a cool, dry place."

Senator HUMPHREY. I know the package. But what about the crude drugs that you buy? Do you have those in your warehouses and in your factory?

Mr. RITCHIE. I prefer not to answer any questions regarding the formula.

Senator HUMPHREY. I am not asking about the formula. The formula is a very different thing entirely. I would not insist at all that you tell us how many parts of this you put in and how many parts of that. I am not asking about that. That is your trade secret, and you have a right to protect that. I am only asking a very simple question. Do you, for the protection of your commodity and the basic drugs that you use—do you use these controls that I mentioned?

Mr. RITCHIE. I have very close controls.

Senator HUMPHREY. Such as temperature and humidity?

Mr. RITCHIE. All the way down the line, such as what I will keep to myself.

Senator HUMPHREY. You are surely controlling that well. I want to know about the other.

Mr. RITCHIE. I think that is the extent of the information that I want to give on the subject.

Senator SMATHERS. May I ask a question, Mr. Chairman?

Would you yield for one question that I am not clear on?

The CHAIRMAN. Senator Humphrey has been privileged to interrogate the witness. But if Senator Humphrey——

Senator HUMPHREY. May I yield to Senator Smathers? He said that he had something he wanted to follow up.

The CHAIRMAN. Yes, indeed.

Senator SMATHERS. On these tests that were conducted by the Bureau of Standards in 1952, you said, in reply to my original questions, that you merely observed, but did not actually participate. Is it not a fact that Mr. Harrell was there, who represented you, the patentee, and Mr. Guelette represented you, and is it not a fact that Mr. Ritchie was present when these tests were run by the Bureau of Standards, and actually participated in the operation of the tests?

Mr. RITCHIE. No, sir.

Senator SMATHERS. What is the fact?

Mr. RITCHIE. The facts are that Mr. Harrell picked the batteries out on what I guess you would call a joint venture between myself and the National Bureau of Standards. They furnished the batteries, and Mr. Harrell pulled them down.

Senator SMATHERS. Mr. Harrell was not employed by the Bureau of Standards, was he?

Mr. RITCHIE. No, sir, he was not employed by me, either.

Senator SMATHERS. He was Mr. Ritchie's representative, was he not?

Mr. RITCHIE. Yes, I think you would say that. He was one of my dealers. He tore the batteries down, put them back together and delivered them to the Bureau of Standards. That ended his participation in the tests up to that point. The batteries were set in on the charging tables and hooked up, and I was invited to see the hookup. I saw that. Then I was shooed away and told to come by when the test was completed and inspect the plates.

Mr. Harrell and I were out in the afternoon, when they opened the batteries for inspection, and inspected the plates. It was very obvious that the acid had become very high in the batteries, and there was no way of telling one plate from another, whether it was a treated plate or an untreated plate.

Senator SMATHERS. My question however, is this, that Mr. Harrell was a dealer of yours and not a representative of the Bureau of Standards?

Mr. RITCHIE. True.

Senator SMATHERS. And he was there when this test was arranged for, and participated in the setting up of the test?

Mr. RITCHIE. No, he didn't participate in the setting up of the test.

Senator SMATHERS. Did you not say he was there when they hooked up the batteries?

Mr. RITCHIE. No, I did not. In fact, I don't recall whether he was even on the ground when the batteries were hooked up. He delivered them there, I believe, the day before.

Senator SMATHERS. Was Mr. Guelette there?

Mr. RITCHIE. Yes, I believe he was these. Yes, he was there.

Senator SMATHERS. And was Mr. Ritchie there?

Mr. RITCHIE. When they hooked the batteries up?

Senator SMATHERS. Yes.

Mr. RITCHIE. No.

Senator SMATHERS. When was Mr. Ritchie there?

Mr. RITCHIE. Mr. Ritchie was there after they hooked the batteries up, but before they turned the chargers on and before they treated them; and the Director of the Bureau of Standards went in with a helper and treated the batteries himself, with his own hands, I understand.

Senator SMATHERS. So the fact of the matter is that during this test you were either there or Mr. Harrell or Mr. Guelette?

Mr. RITCHIE. Mr. Guelette was there, but Mr. Guelette was not allowed to take any notes of any kind or to give any information that would give me any idea what was going on.

Senator SMATHERS. That is right. So you did have these representatives there? When you were not there, Mr. Guelette or Mr. Harrell was there?

Mr. RITCHIE. That is true.

Senator SMATHERS. That is all.

Senator HUMPHREY. I just have a few more questions.

The CHAIRMAN. Is that all the questions the Senator has?

Senator HUMPHREY. I want to ask this question.

I read in the Daily News here in Washington, D. C., that Dr. Laidler was your consultant. Is that correct?

Mr. RITCHIE. Dr. Laidler was at one time my consultant on the problem with the Post Office Department; yes.

Senator HUMPHREY. When did you first meet him?

Mr. RITCHIE. I believe it was in March of 1952.

Senator HUMPHREY. March of 1952. Did he make an analysis of Circular 504 and various documents pertaining to the battery additives for you?

Mr. RITCHIE. We got hold of Dr. Laidler through the Library of Congress——

Senator HUMPHREY. Yes.

Mr. RITCHIE (continuing). And turned over to him, who was a total stranger to us at that time, and who was leaving town, the test and field data that we had on Battery AD–X2, and we turned over to him all the tests that we knew of by the National Bureau of Standards up to that time. And he went out, I believe it was out in Iowa some place, and took this material with him. He evaluated the material during his trip out there to determine whether or not, in his opinion, his scientific judgment, we had sufficient material to support our case with the Post Office.

Senator HUMPHREY. Now you have not only said that he was your consultant, but also your writer. Now to what does that refer, so that we may have the record straight on this, Mr. Ritchie?

Mr. RITCHIE. I am doing considerable writing.

Senator HUMPHREY. You mean, he helps you just in the preparation of some of your own personal writings?

Mr. RITCHIE. Yes, sir. I have just finished writing a book on this subject. I am looking for a publisher, incidentally.

Senator HUMPHREY. I think you are going to get one, too.

Mr. RITCHIE. And my English is atrocious. Dr. Laidler helps me here with my English, like Mr. Hager does when I am in my home office.

Senator HUMPHREY. Would you supply the committee with a complete collection of everything that Dr. Laidler has written for you about AD–X2 in any of its forms?

Mr. RITCHIE. I believe I have already done that, sir.

Senator HUMPHREY. You have done that?

Mr. RITCHIE. Yes.

Senator HUMPHREY. Thank you.

Now, who arranged for Dr. Laidler's introduction to this committee?

Mr. RITCHIE. That is a rather difficult question to answer, for this reason: Dr. Laidler had been helping me with this situation, and due to some difficulties with the Directors of the Bureau of Standards, he reached the conclusion that he had better not work for me any more, and the committee was just entering into the thing then, and what you would say really taking an interest in the situation, and they had no technical help. I believe that the committee felt at that time that possibly Dr. Laidler's academic freedom was threatened, and they asked him. To the best of my knowledge, they knew at that time that he had been helping me.

Senator HUMPHREY. You say that the committee did know——

Mr. RITCHIE. I say, I believe, because I say there was a great deal of confusion during this period of time, because the committee was trying to get Dr. Stacey, of the Canadian Standards Association, and Dr. Glastone, and Dr. De Bethune. They were trying to get anyone who could help them with the patent society there, because the committee at that time I think was pretty dubious that the argument between myself and the Bureau of Standards was anything except within my imagination.

Senator HUMPHREY. Was this committee told that Dr. Laidler was your paid consultant and writer?

Mr. RITCHIE. I couldn't answer that truthfully, Senator, because they——

The CHAIRMAN. I might assist at that point. I was not the chairman of the committee at that time. This took place, I believe, in October of 1952, or possibly earlier. But Mr. O'Connor of the staff of the Small Business Committee was serving on that staff under Senator Sparkman's chairmanship, and is still serving on that committee. If that question needs to be answered specifically, I am sure that Mr. O'Connor can answer the question specifically, because he has been on the committee's staff, not only in the calendar year of 1952, but he is still on the committee's staff. I believe that Mr. O'Connor was working directly on this question all throughout the recess period of Congress of 1952. So if that question needs to be answered, Mr. O'Connor can give the detail.

Senator HUMPHREY. I will ask the question in just a moment. But did Dr. Laidler write endorsements of AD–X2?

Mr. RITCHIE. I would rather say he wrote a factual report of Battery AD–X2.

Senator HUMPHREY. Would you consider those factual reports to be endorsements?

Mr. RITCHIE. No, sir. I believe they are not.

Senator HUMPHREY. Were they laudatory or commendatory of AD–X2?

Mr. RITCHIE. Yes. The facts bore out a favorable report.

Senator HUMPHREY. And had that happened before his employment by the committee?

Mr. RITCHIE. Yes.

Senator HUMPHREY. I think it would be well to know whether Dr. Laidler's services with you, Mr. Ritchie, were known to the committee before he was hired as the technician to investigate into this case.

I am not asking this question of you. I shall ask Mr. O'Connor to make that information available for the record. I do not think that he needs to answer it right at this moment, since he is not before us.

I have no further questions.

The CHAIRMAN. Senator Schoeppel?

Senator SCHOEPPEL. Mr. Ritchie, as I view it—I may be wrong—but probably the central issue here is whether AD–X2 helps batteries or not. That is what we are trying to find out. That is what you contend that it does do, is it not?

Mr. RITCHIE. Yes, sir.

Senator SCHOEPPEL. Now, my impression has been—I do not know whether I am right or wrong—that the Bureau of Standards has nothing to do with the formula. They are trying to ascertain the results. Is that not about the crux of the thing here?

Mr. RITCHIE. Yes.

Senator SCHOEPPEL. Now, why that becomes important is this. Is the use of AD–X2 by the large commercial users important to them? Some of them indicate that it is, because they have kept pretty good records on the results of this; have they not?

Mr. RITCHIE. Well, a battery, Senator, is a very strange thing. A battery can cost you 3 or 4 times its price, especially in large equipment, and the result is that large operators keep pretty close track of their batteries. As I said yesterday, we have been working principally with large industrial accounts. We have not been going to the individual car owner. I do not think 2 percent of our business is with the individual car owner. I do not think that there is 1 percent of it. It is mostly with large fleet operators who know batteries, and know how to take care of batteries. And the people who know how to take care of them naturally know the cost of batteries, and they seem to think that the material is important to them, because they give us money year after year for the material.

Senator SCHOEPPEL. And you have every reason to believe that they have kept a pretty good record of the operation of these batteries?

Mr. RITCHIE. Yes, sir, I do.

Senator SCHOEPPEL. That is all.

The CHAIRMAN. The committee will stand in recess until 2 o'clock.

(Whereupon, at 12:35 p. m., a recess was taken until 2 p. m., the same day.)

AFTERNOON SESSION

The CHAIRMAN. May we please come to order? We will proceed with the afternoon committee hearing.

Senator Gillette, do you care to ask Mr. Ritchie any further questions?

Senator GILLETTE. No additional questions, Mr. Chairman.

The CHAIRMAN. Then we will proceed with Dr. Astin for this afternoon.

Senator GILLETTE. Just a moment, Mr. Chairman. There was a question I wanted to ask. Is Mr. Ritchie here?

The CHAIRMAN. I am sure Mr. Ritchie is still here. Yes, there he is. If you wish to ask Mr. Ritchie a question, you may ask him a question, and then we will proceed with Dr. Astin.

Step up, Mr. Ritchie, so that you may hear the Senator's question.

TESTIMONY OF JESS M. RITCHIE, PRESIDENT, PIONEERS, INC.—Resumed

Senator GILLETTE. I wanted to ask you, Mr. Ritchie, with reference to the package in which you were selling your product, for how much money have you been selling those packages?

Mr. RITCHIE. The package retails for $3.

Senator GILLETTE. $3 for one of those packages?

Mr. RITCHIE. Yes, sir; three envelopes are enough for the treatment of one group 1 or group 2 automotive type storage batteries.

Senator GILLETTE. How many packages can you get from a pound of your product?

Mr. RITCHIE. I believe it is 2¼ pounds to the dozen.

Senator GILLETTE. Two and a quarter pounds to a dozen?

Mr. RITCHIE. Yes, sir.

The CHAIRMAN. Mr. Ritchie, is that a dozen packs?

Mr. RITCHIE. Yes; that is a dozen packages of three each.

The CHAIRMAN. There are 3 envelopes in each package, which are for the normal 3-cell battery?

Mr. RITCHIE. Yes, sir.

Senator GILLETTE. And you say that a batch that you make up or had made up under your supervision was substantially a batch of 3 tons at a time, or 6,000 pounds?

Mr. RITCHIE. Yes, sir.

Senator GILLETTE. That is all, Mr. Chairman.

The CHAIRMAN. Thank you.

The committee is going to place in the record Exhibit No. 16, copies of correspondence between the National Bureau of Standards and the National Better Business Bureau.

(The document referred to was marked "Exhibit No. 16" and appears in the appendix.)

The CHAIRMAN. Dr. Astin, would you come up to the table, please. You may have anyone with you, Dr. Astin, whom you desire.

Dr. ASTIN. I do not believe it is necessary for the start, Senator.

The CHAIRMAN. Thank you.

Dr. Astin, would you please submit to the oath, sir. You swear that the testimony you are about to give pertaining to the matter now before this committee is the truth, the whole truth, and nothing but the truth, so help you God?

Dr. ASTIN. I do.

TESTIMONY OF DR. ALLEN V. ASTIN, DIRECTOR, NATIONAL BUREAU OF STANDARDS

The CHAIRMAN. Dr. Astin, you may proceed in whatever manner you may desire. I hope that we may give Dr. Astin the courtesy of permitting him to make his full statement, and then we will proceed with the questioning to the full wishes of all the committee members.

Dr. Astin, do you have additional copies of your statement?

Dr. ASTIN. Oh, I do not at the present time, but I expect some later.

The CHAIRMAN. You expect some later. All right.

You may proceed, Dr. Astin.

Dr. ASTIN. Mr. Chairman and members of the Senate Small Business Committee, I appreciate this opportunity to appear before the committee in order to attempt to clarify some phases of the controversy involving the work of the National Bureau of Standards on battery additives.

First, I should say that I believe, on strictly technical phases of the battery-additive problem, disagreements should be resolved by a group of technical experts.

I am pleased that a committee of the National Academy of Sciences was recently set up for such a purpose and I have no hesitancy in seeing the Bureau's work on this matter subjected to their critical scrutiny. I have, in fact, urged such an investigation ever since it was apparent that responsible individuals had doubts as to the adequacy of the Bureau's work on battery additives. There are, nevertheless, a number of aspects of the battery-additive matter that can be readily discussed here.

In order to provide a suitable background for my statement on battery additives, I would like first to give a brief review of the Bureau's functions and operations and a description of its testing procedures.

The authorized functions and activities of the National Bureau of Standards are given in the act of March 3, 1901, establishing the Bureau, 31 Statute 1449, as amended by Public Law 619 of the 81st Congress. These are:

(a) The custody, maintenance, and development of the national standards of measurement, and the provision of means and methods for making measurements consistent with those standards, including the comparison of standards used in scientific investigations, engineering, manufacturing, commerce, and educational institutions with the standards adopted or recognized by the Government.

(b) The determination of physical constants and properties of materials when such data are of great importance to scientific or manufacturing interests and are not to be obtained of sufficient accuracy elsewhere.

(c) The development of methods for testing materials, mechanisms, and structures, and the testing of materials, supplies, and equipment, including items purchased for use of Government departments and independent establishments.

(d) Cooperation with other governmental agencies and with private organizations in the establishment of standard practices, incorporated in codes and specifications.

(e) Advisory service to Government agencies on scientific and technical problems.

(f) Invention and development of devices to serve special needs of the Government.

The activities necessary to carry out the six authorized basic functions include research and development in all major fields of physics, chemistry, metallurgy, engineering, and mathematics. In general, the Bureau's activities can be grouped under either of two major objectives: (1) To serve the Government as a scientific laboratory and (2) to serve the Nation's science and industry by establishing and maintaining the fundamental standards of science, related instrumentation and measurement methods, and the provision of such services as calibration.

The technologic nature of our economy requires uniformity and precision of measurement if, for example, mass production is to be feasible. For such reasons, the Bureau's work in scientific standards and measurement represents a cornerstone of commerce, industry, and science. These scientific standards range from the meter and

kilogram (and the derived yard and pound) to devices that provide standard radio frequencies. The number has grown from a few in the early days of the century to several hundreds. As science and technology have advanced, greater and greater precision has been required in basic standards of the classical kind (like length and mass) while new fields have opened requiring new standards and methods of measurement (like the higher radio frequencies and atomic energy).

The application of the Bureau's research, development, and service activities is diffused throughout all of science, industry, and commerce. Most basic commodities like wheat, steel, and coal are bought and sold on a weight basis, for example. The accuracy and uniformity of scales for such transactions depends upon the Bureau's work in mass. The Bureau itself, in cooperation with the railroads, calibrates master track scales throughout the country. Ordinary weighing devices are calibrated against State standards, provided and periodically checked by the Bureau. Precision weights for chemical analysis are calibrated in the Bureau's laboratories. Also standard samples, materials of precisely-determined physical and/or chemical properties, are supplied for reference or control purposes in the Nation's industrial and scientific laboratories.

The control of dimensions in mass-production industries depends upon the standard of length and associated instruments, measurement methods, and calibration services. For example, the mass production of uniform pistons in the automobile industry depends initially upon calipers and micrometers used in the shop. These instruments are checked by a given company against its master gage blocks. The master gage blocks are periodically submitted to the Bureau for calibration against the Bureau's standards. The actual method of calibration is optical in nature, linked back to the standard meter.

The diversity in our basic standards is directly related to the diversity of our economy. Thus, standards exist and are needed in electricity, optics, mechanics, electronics, chemistry, atomic and nuclear physics, and so forth. Their applications take a similar diversity of form. Standard radio frequencies, obtained from crystal clocks of high precision and associated complex electronic instrumentation, are provided through continuous broadcasting over station WWV (Maryland) and WWVH (Hawaii).

These frequencies are used in such ways as the following: Broadcast stations use the signals to keep their transmitters in channel; manufacturers of electronic equipment use them to calibrate their oscillators and various electronic devices; musical instrument companies use them to calibrate the tone of their instruments; utilities use them to control the 60-cycle frequency of their electrical generators, ensuring, first, that the power produced will be appropriate for the various machines that are designed for such power, and, second, that such frequency dependent devices as electrical clocks are kept accurate.

Even medicine and biology depend upon fundamental standards in the physical sciences. X-ray standards provide proper dosage information and protection provisions not only for industrial X-ray installations but hospital ones. Radioactive isotope standards provide a method whereby tracer research can be conducted and also provide the dosage and protective information needed for medical therapy.

The magnitude of the Bureau's operations can be appraised from a brief look at the operating budget. For fiscal year 1953 the total obligations will approximate $50 million. Of these, about $42 million or about 85 percent represents work requested and paid for by other agencies of the Federal Government and justified before the Congress in the budgets of these other agencies. Within this 85 percent the primary effort is on important defense projects for the Army, Navy, and Air Force and the Atomic Energy Commission. The remaining $8 million or approximately 15 percent represents the budget provided directly to the Bureau by the Congress to carry out its basic functions.

Growing out of the latter portion of the program—that comprising the 15 percent—are the calibration, testing and related services, which constitute 4 percent of the total activity. The bulk of this activity—approximately 3 percent—has to do with calibration services. These are services characterized by the comparison of master standards in commerce and industry with the national standards (e. g., gage blocks that I mentioned from industry are periodically submitted for calibration, by optical means, in order to ensure that the gage blocks provide uniform and accurate measurements).

The testing of commodities done by the Bureau comprises approximately 1 percent of the activity. Most of this commodity testing is concerned with checking for compliance of materials purchased by the Government with the specification in the purchase contract. The Federal system of purchasing, in order to give all businesses a fair and equal opportunity to compete for Government contracts, involves the issuance of bid documents specifying what the Government wishes to purchase. These bid documents contain data describing the item to be supplied, and the data must be technically adequate wherever possible in order that the proper type of item be purchased and that the competing firms be, in fact, bidding to supply the same, desired item. Responsibility for specifications and the general procedures rest with the General Services Administration. The largest item—totaling more than half of this 1 percent of testing done by the Bureau—is cement.

A relatively small part of this small testing program, wherein the Bureau acts as a service laboratory for other Government agencies, is concerned with tests for agencies having regulatory authorities. The total of all regulatory type testing done for these other agencies, at their initiation and request, is less than $25,000 per year. In short, testing of this kind done by the Bureau comprises less than a twentieth of 1 percent of the total NBS program. It is within this category that the Bureau's interest in the battery-additive matter originated.

Altogether, the Bureau makes about 300,000 individual calibrations and tests per year and in addition issues over 30,000 standard samples.

In the calibration activity, which involves the comparison of measuring instruments with the national standards for physical measurement, the Bureau performs a unique service. Accordingly, this service is made available not only to other Government agencies but to State institutions, industrial and university laboratories, and to the general public. In contrast, in the commodity testing activity, similar services are frequently available in private testing laboratories; therefore, the Bureau's work in this area is confined to serving other Government agencies in connection with their purchasing or regulatory

responsibilities. Occasionally a testing problem arises where the Bureau's facilities are unique or where its services are desired for referee purposes, and under such circumstances a commodity test might be performed for the general public.

The Bureau has no program of endorsing, approving, or condemning proprietary products. This fact is frequently not understood by the public since we receive many requests for such service which have to be turned down. There are also occasional claims of NBS approval in the advertisements of some products. These can usually be corrected by correspondence.

The reports the Bureau prepares on tests of materials and products for other Government agencies are considered the property of the agency for whom the test is made. Consequently, the control of the dissemination of the information in these reports is the responsibility of the agency requesting the test. Also, the application and interpretation of these reports to the operating requirements of these other agencies is the responsibility of the agency for whom the test is made.

Frequently, in the course of its testing work, the Bureau accumulates general information on classes of materials and products that is of interest and importance to the public. In many of these cases publications are prepared for general distribution in which references to specific proprietary products is avoided. Occasionally there are publications, in which brand-name products are identified, but this is done with the consent and cooperation of the manufacturers involved. A notable example is in the publication of data on the acoustical properties of materials. These data are determined at the joint request of building and manufacturing groups, and the results are of appreciable value to architects and construction engineers in their design problems. But even in this case no attempt is made to provide an overall evaluation or an approval of a particular item. Also in such cases the Bureau does not permit the use of its name by manufacturers for advertising or promotion purposes.

Legal authorization for the publication of information obtained by the Bureau in its operations is provided by the basic legislation previously mentioned. The act provides for "the compilation and publication of general scientific and technical data resulting from the performance of the functions specified herein or from other sources when such data are of importance to scientific or manufacturing interests or to the general public, and are not available elsewhere, including demonstration of the results of the Bureau's work by exhibits or otherwise as may be deemed most effective."

Since the act specifically refers to a consideration of the importance of the data to scientific or manufacturing interests, serious effort is made in establishing priorities in the Bureau's publications program to making determinations of such interests. In fact, many of the Bureau's publications are initiated as a result of requests from professional groups or associations of manufacturers. In all cases, however, there is a careful attempt made to insure that the publication will be of broad general interest and that it will be completely impartial in the presentation of data. The latter requirement can be largely met by confining the reports to straightforward presentations of scientific and technical data on the properties of the materials and devices investigated.

A laboratory study on the properties of aluminum under a particular set of environmental conditions might disclose characteristics for aluminum superior to those of steel under the same set of environmental conditions. The publication of such data would not be considered as prejudicial to those interested in promoting the use of steel; rather the withholding of such data would be considered prejudicial to the interests of the general public and those interested in promoting the use of aluminum. In science and technology a specific, reproducible observation is a fact that knows no favorites.

An interesting example of the way the Bureau fits its publications program to the interests of the general public is given by a report put out sometime ago on hearing aids. The initiation of this report was due largely to requests received from medical groups and groups interested in the rehabilitation of the hard of hearing. There was also some interest in the publication on the part of the hearing-aid industry. After the report was distributed, some individuals in the hearing-aid industry objected to the report on the grounds that it was prejudicial to their particular interests. Consequently, an extensive survey was made of the entire hearing-aid industry as to their interest in the report and its general usefulness to the public. Also included in this new survey were the groups initially responsible for initiating the request for the report. As a result of this survey a number of important suggestions were obtained for a revision of the report. Consequently, the first report was withdrawn and a revised one issued which incorporated a broad consensus of interests and usefulness.

I would next like to discuss briefly some aspects of the Bureau's testing program, particularly in relation to the development of accurate and reliable testing techniques and procedures. Here it is necessary to stress the importance of measurement in the progress of science and technology. The advancement of science and technology depends to a very appreciable extent on observations of materials and devices under various environmental conditions.

In order for these observations to be useful in furthering the progress of science, it is essential that they be reduced to numbers so that comparisons can be made between the behavior of materials under different sets of environmental conditions. Furthermore, it is important that these measurements be expressed in numbers which have the same meaning in different laboratories. This, in turn, means that we have to have units and standards for measuring. Providing the latter, of course, is a primary and unique function of the National Bureau of Standards. Thus, the Bureau, because of its basic function, is very intimately concerned with the measurement problem. The organization, therefore, gives substantial effort and emphasis to the development of accurate and reliable measurement techniques. Appreciable attention is also given to the development of instruments and equipment by which measurements can be made under various environmental conditions.

Because of the importance of instruments and measurement to all fields of science, most of the major professional societies have standing committees assigned to instrument and measurement problems. One very important group is the American Society for Testing Materials. This national society is an affiliation of leading professional organizations, and individuals, manufacturers, and consumer groups with

interest in the testing problem. The concern of the society is to develop uniform testing procedures so that when measurements on a particular material and device are made in one laboratory, these measurements will have a definite and reproducible meaning to an engineer in another laboratory. The extent of the Bureau's interest in the important work of the American Society for Testing Materials is shown by the fact that a total of over 400 positions on ASTM committees are held by Bureau personnel. Of these, 13 represent chairmanships of main committees dealing with such diverse subjects as magnetic properties, cements, gypsum, asbestos products, porcelain enamel, electrical insulation, spectroscopy, textiles, wax polishes, plastics, adhesives, and analysis of metals. In addition, 43 other staff members are chairmen of working subcommittees or special task groups.

Closely related to this example is the widely recognized fact that progress in science and technology is greatly dependent on the free interchange of information between specialists. Thus effective improvement of measurement and testing techniques requires collaboration between the members of groups working on similar and related problems. For this reason the Bureau consults and cooperates with a wide range of industry and university scientists and engineers on a variety of technical problems of mutual interest. In the battery field we work closely with various experts in the battery industry, both in the development of new principles and techniques for new and improved types of batteries and in the development of more reliable evaluation techniques.

Another example of the interest and effort the Bureau devotes to the development of advanced and reliable testing procedures is shown by the formation a few years ago of a statistical engineering laboratory, which gives substantial attention to the improvement of the techniques of experimentation. The statistical quality control procedures which have been so widely adopted by industry during the last decade are but a small part of the new statistical tools now proving invaluable in experimental work, whether this work is concerned with scientific research, engineering, development, testing, or operations analysis. These new tools are especially concerned with the achievement of objectivity in experimentation, in testing, and in the setting of more exacting standards for drawing scientific conclusions. The Bureau has taken leadership in applying modern statistical experimental design to large-scale laboratory operations and has assembled an outstanding staff that has won a worldwide reputation. As a consequence, this staff has been deluged with requests for lectures, and many of the country's leading universities and other laboratories periodically borrow members of this staff. In fact, very frequently, when difficult, expensive or crucial experiments are involved there is a strong likelihood that a visit will be made to the NBS statisticians. The Hoover Commission made particular reference to the outstanding work of this group.

As a technical laboratory, the National Bureau of Standards is concerned with the development of scientific and technical information and the analysis and interpretation of such information. As explained before, this information should be in a form that can be expressed in numbers, with the conditions under which the information was obtained clearly and specifically defined. Since scientific analysis and

conclusions must be based on well-defined observational techniques and procedures, it is not possible to give consideration to observations of a general qualitative nature and under environmental conditions which are poorly defined or not defined at all.

Very often in scientific or engineering work one is concerned with the effect of some modification in the treatment or handling process on the behavior characteristics of the material or device under investigation. This involves comparative measurements, and whenever comparative measurements are important it is essential that there be a standard or base to which the measurements can be referred. Since we are concerned with the battery-additive matter it will probably be best to take this as the example. First, we have to consider what measurements are of importance in evaluating battery performance. Batteries are intended to supply electrical energy. Hence, it is important to have some criteria by which a battery's ability to supply electrical energy can be measured. This is usually done in watt-hours or ampere-hours assuming a constant voltage. The next most important characteristic in evaluating battery performance is its probable life. For automobile storage batteries this is usually expressed in terms of months or years. Another important measurement on a storage battery is its efficiency; this involves the ratio of the energy necessary to charge a battery to the energy the battery can return in doing useful work. Many other types of measurements can be made on batteries, such as voltage at the terminals, hydrometer readings, temperature, and so forth, but usually those observations are related to attempts to measure its ability to supply electrical energy or to its efficiency. The rigorous measurement of the life of a battery is somewhat difficult and is usually related either to the condition when the battery will no longer supply sufficient energy to be useful or when its efficiency becomes so low that it is impractical to operate it further. In general, the efficiency of a battery will decrease as it ages, and estimates of the expected life of a battery may be made by measurements on the change in efficiency with time or with use.

If now we are concerned with the effect of a particular addition to the electrolyte of a battery on its performance, we must first of all have a measure of the performance to be expected without the change in the electrolyte. This means that we must have measurements on 2 groups of the batteries: 1 in the original or unchanged state and 1 containing the modification which is to be evaluated. It is further important that the subsequent exposure or handling conditions of the two groups of batteries be as nearly alike as possible, since changes in environmental conditions might themselves affect the measurements on performance. Also, it is important that the two groups of batteries in their initial state be as nearly alike as possible. If there are uncontrolled variations in either the initial conditions of the two groups of batteries or their subsequent exposure conditions, it will be necessary to take observations on large numbers of batteries in the hope that the individual differences either in initial condition or subsequent exposure will be averaged out. In planning experiments to insure that such conditions are met it is possible to make appreciable use of modern developments in the statistical design of experiments, as the Bureau has done.

If one is able to discover in controlled laboratory experiments of the sort just discussed, an effect which offers improvement in battery

performance it would next be necessary to extend the tests to be sure the effect or improvement still persists under the more rigorous conditions of actual use. This would probably involve what have been commonly referred to as field tests. There has been some criticism of the Bureau's work on battery additives, because we have not as of the present time resorted to field tests. The Bureau has, however, had extensive experience in field-testing procedures and in the development and evaluation of field-testing procedures for a variety of purposes. One of the most important of these is in the ordnance work which the Bureau has done for many years for the Department of Defense. In the development of a new ordnance device the field test is the final stage of evaluation and approval. The field test, however, is not resorted to until some improvement or effect is developed in the laboratory which would then make the field tests worthwhile. The field test usually differs from the laboratory test in that the environmental or exposure conditions are either more severe than can be provided in the laboratory or more realistic than can be duplicated. The Bureau has not resorted to field tests with battery additives, because it has not been possible to find in the laboratory any effect which is related to the normal use of lead-acid batteries. If a pertinent effect were found in the laboratory, then a field test might be necessary before a final evaluation could be obtained. Since, however, no worthwhile effect has been found in the laboratory it has been concluded that the field tests would serve no useful purpose. Furthermore, in field testing, large variations in environmental conditions are likely, and it requires much more extensive planning, larger samples, and more rigorous analysis of the data to obtain results of reliability and significance.

The Bureau's work on batteries goes back to the very beginning of the organization, at which time it dealt with work on the primary standard of electromotive force, the volt. This standard was derived from a cell of very special construction called the Weston standard cell and throughout the years there has been appreciable work in improving the stability and reliability of the standard cell and on methods for measuring the voltage of the standard cell with greater accuracy. Other work on batteries has involved investigations of the fundamental processes of converting chemical energy into electrical energy and in the development of a variety of types of batteries for specialized applications. An example in the latter category is the development of a special reserve-type battery for use in radiosondes, the devices with which information on weather phenomena in the upper atmosphere is obtained reliably, quickly, and efficiently. In the reserve battery for the radiosondes it was necessary to obtain a battery very light in weight, of extremely long shelf life, and capable of operating at the very low temperatures of the upper atmosphere. Other work in the development of batteries has involved applications to a number of specialized military requirements such as use in aircraft, in guided missiles, in submarines, and in proximity fuzes. Thus, our staff is constantly alert and experienced in the development of new and better batteries.

Closely related to our work on the development of batteries is our work on devising improved instruments and techniques for the evaluation of batteries. Many of the batteries purchased by other Government agencies for their particular needs are ordered to conform to

specifications designed to meet the particular requirements of the using agency and to insure that the Government obtains the highest quality at the lowest cost. In order to determine conformance of batteries with specifications, it is naturally necessary to have well-established techniques for testing and evaluating battery performance. In these activities the other Government agencies have drawn extensively on the staff and facilities of the National Bureau of Standards for assistance.

The Bureau's work with battery additives, materials intended to improve the performance of lead-acid type storage batteries, goes back to the early 1920's. A technical paper summarizing the results of these early investigations was published in the transactions of the American Institute of Electrical Engineers in 1925. Around this same period the Federal Trade Commission made its first request to the Bureau for the evaluation of an additive to determine if it conformed with the advertising claims made by its manufacturer. Also in 1925 the Bureau issued in its Technical News Bulletin a brief statement discussing the effect or absence of effect of battery additives on the performance of lead-acid storage batteries. During the next 6 years a number of other additives were examined for such agencies as the Federal Trade Commission, the Post Office Department, and the Navy Department. During this interval numerous requests for information on additives were received by the Bureau from the general public and in 1931 a mimeographed leaflet was prepared in order to facilitate the problem of replying to these inquiries. This leaflet was designated as Letter Circular 302 and entitled "Battery Compounds and Solutions." The leaflet provided some general information about battery additives and pointed out that the Bureau had found none of them to be effective in improving the performance of batteries. From 1931 to the start of World War II nine other battery additive materials were investigated either for the Federal Trade Commission, the Post Office Department or Members of the Congress. Most of these consisted primarily of combinations of sodium and magnesium sulfates, commonly known, respectively, as glauber salt and epsom salt. During World War II and since, 15 new additives were tested by the Bureau (some for a second time) for other Government agencies. Again most of these consisted of mixtures of sodium and magnesium sulfates. The Bureau also investigated a large number of materials considered as possible corrosion inhibitors to see if any of them would curtail the sulfation of lead-acid storage batteries that occurs on storage. This latter study was undertaken to determine the best means to recondition or store lead-acid batteries that were in surplus at the termination of World War II. Included in this latter test were again sodium and magnesium sulfate mixtures; they were found not to be beneficial. In response to the continuing demand for information from the public about battery additives, Letter Circular 302 was reissued in 1949 with only minor variations from its original form.

The first recorded contact at the Bureau with the Battery Additive AD–X2 occurred in April 1948 when Dr. Merle Randall, consultant of Pioneers, Inc., wrote to Dr. George W. Vinal, the Chief of the Bureau's Electrochemistry Section. Dr. Randall described AD–X2 (it was then called Protecto-Charge) as a powder mixture of anhydrous sodium sulfate and slightly basic nearly anhydrous magnesium sulfate and he claimed that this combination of the salts yielded re-

sults appreciably different from ordinary mixtures of the two salts. It might be of interest to point out that in this letter Dr. Randall claimed that the additive was an invention of one Donald Kiefer, the patent rights to which had been acquired by Mr. Jess M. Ritchie, president of Pioneers, Inc., the company which manufactures the additive. Dr. Vinal deferred replying to Dr. Randall's letter and again in June of 1948 Dr. Randall wrote Dr. Vinal, reemphasizing and expanding the claims made for this material in his first letter. Included with his second letter was a special test which we have subsequently called the Randall test and which was claimed to be a very severe test for these additives and which yielded "striking results." There followed during the next month several letters between Dr. Vinal and Dr. Randall in the last of which Dr. Randall stated, "I do not wish to unduly prolong our conversations" which Dr. Vinal apparently interpreted as an opportunity to break off the correspondence since the latter was unanswered. In these comments Dr. Vinal attempted to point out to Dr. Randall where some of his claims were not in accordance with accepted theory and in which Dr. Randall indicated that the statements made in the Bureau's Letter Circular 302 were true for all other additives but not for AD–X2. Also, in one of Dr. Randall's letters of July 1948 was a statement that in one experiment with these additives, treated batteries had remained in service without a single failure for as long as 17 months. This is interesting in the light of more recent statements that the additive was not invented until the fall of 1947. Late in 1948 the Bureau received inquiries about Mr. Ritchie's product from two new sources. Senator Knowland sent to Dr. Edward U. Condon, then Director of the Bureau, a file forwarded to him by Mr. Ritchie with the request, "if in line with the policy of the Bureau of Standards, it would be appreciated if such a test could be made so that this product could stand on its own merits." Mr. Jack A. Harris, then general manager of the Better Business Bureau of Oakland, Calif., wrote to Dr. Vinal requesting that the Bureau make a test of AD–X2. Also there had been correspondence with the National Better Business Bureau requesting guidance in handling claims that AD–X2 should be exempted from the general statements of battery additives in Letter Circular 302.

In Dr. Condon's reply to Senator Knowland, he pointed out that tests on the material were currently being made by the Signal Corps Laboratories at Fort Monmouth and by the New York and Mare Island Navy Yards, and, accordingly, tests by the National Bureau of Standards were probably unnecessary.

About the 1st of January 1949 the Bureau had started a series of tests on another battery additive for the Federal Trade Commission and it was decided that it might be of interest to run along with these tests an evaluation of AD–X2. Samples which had been transmitted by the Oakland Better Business Bureau were used for this purpose. Part of these tests included careful chemical and physical determination of the constitution and structure of AD–X2 since Dr. Randall's letters had claimed that the combination in AD–X2 had unique properties and was not a simple mixture of sodium and magnesium sulfates. The Bureau's tests have shown that the material is primarily a simple mixture of sodium and magnesium sulfates and that there is no evidence of a compound or alum structure. The analysis also showed a

number of trace elements but for the most part these are the same trace elements usually found in varying amounts in commercial grades of sodium sulfate and magnesium sulfate or in the normal battery electrolyte. It is also pertinent to note in connection with the claim of the uniqueness of the composition of AD–X2 that our analyses have shown variations between samples as high as 19 percent in the ratio of sodium sulfate in AD–X2 to the magnesium sulfate. The ratio of the quantities of trace elements also vary appreciably.

The results of these tests showed that the effect of AD–X2 in a battery electrolyte was no different than that of other mixtures of sodium and magnesium sulfates and that none had any measurable effect on the performance of a lead-acid storage battery. Two testing procedures were used. One was the Randall test which was claimed by Mr. Ritchie's consultant to yield striking results; the other was a modified life-cycle test, similar to the standard test which is widely used to estimate the life of a storage battery under normal use conditions. A life-cycle test is used by the Government in its specifications for the purchase of batteries for its own use.

The results of these investigations which were begun in January 1949 were ultimately incorporated in the Circular No. 504, Battery Additives, issued in January 1951, copies of which have been furnished to all members of your committee.

Preparation of the material for Circular 504 was initially planned as a revision of Letter Circular 302. The incentive for this revision was provided partly by the National Better Business Bureau in order to have a more thorough and up-to-date statement on the subject of battery additives. Requests for the revision for the circular began in June 1948, apparently largely as a result of representations made to the National Better Business Bureau by Pioneers, Inc., that AD–X2 should be exempted from any general statements made about battery additives. Correspondence and discussions as to what the new circular should contain continued for many months, and interim statements were prepared for the National Better Business Bureau in March of 1949, and April and July of 1950. The first of these made no reference to specific brand-name products, but the latter two made specific reference to AD–X2. This deviation from the usual practice was at the request of the National Better Business Bureau in order to reply to statements made by the proponents of AD–X2 that the generalization made in prior bulletins did not apply to that product and that it had not been tested by the Bureau. Here it is interesting to quote from a letter from the Oakland Chamber of Commerce to the National Better Business Bureau, a copy of which letter was sent to NBS by the chamber:

> We realize that, for the protection of the public, your pamphlet, Battery Compounds and Solutions, has a definite place, and, were it not for the pamphlet, there would be more evidence of the existence of the "battery-dope racket." However, Pioneers, Inc., should, in our opinion, be definitely excepted as regards such publication. With all due respect to the National Bureau of Standards, whom you quote in your pamphlet, we feel that they have not been exactly cooperative regarding the product "AD–X2" manufactured by Pioneers, Inc.

This quotation is interesting in two respects. First, as to the claim that there is a battery-dope racket and that technical information such as was supplied by the National Bureau of Standards to the National Better Business Bureau serves a useful purpose. Second,

is the reference that the National Bureau of Standards has been uncooperative. There have been many similar statements from other proponents of Battery AD–X2 regarding not only lack of cooperation but even unfairness on the part of the Bureau. I would like briefly to examine this phase of the problem.

First, every action which the Bureau has taken with respect to the testing of AD–X2 and the dissemination of information with respect thereto has been brought about as a direct consequence of the representations and pressures of the proponents of AD–X2. The Bureau became aware of the existence of the product first by approaches made by the manufacturer, and initially declined to make any tests on it because there was no reasonable evidence that the product was, in fact, different from any of the other numerous additives the Bureau had previously tested, and also because the Bureau does not evaluate proprietary products for individual manufacturers. The initial tests made by the Bureau came about largely as a result of inquiries and suggestions from the Oakland Better Business Bureau and from Senator Knowland, their inquiries in turn being instigated by Pioneers, Inc. The subsequent dissemination of information about battery additives came about largely as a result of pressures applied to the National Better Business Bureau to make unwarranted exceptions in the case of Battery AD–X2.

In March of 1950, the Federal Trade Commission requested the Bureau to make tests on AD–X2. A report was sent them on May 11, 1950, incorporating the results of the tests which had been initiated in January 1949. Late in 1951, many members of the Bureau staff gave testimony at the Federal Trade Commission hearing on still another additive and, at that time, members of the Commission stated that they wanted further tests made from samples submitted by the Oakland Better Business Bureau and not by FTC. The Commission formally requested the additional tests in February 1952, and a report based on this new series of tests was submitted in July 1952.

In September 1951, the Post Office Department requested tests on AD–X2. The Bureau submitted a report in December 1951 again based on results of tests obtained on the sample submitted by the Oakland Better Business Bureau. Following receipt of this report, the Post Office Department also requested additional tests on samples submitted by them. Accordingly, the National Bureau of Standards initiated still another series of tests of AD–X2.

The results of the tests made for these two agencies disclosed no beneficial effect of the additive on the operational characteristics of lead-acid storage batteries. The major testing procedure used in the investigations for the Post Office Department and the Federal Trade Commission was the Randall test which has been referred to earlier.

Beginning in July 1951 the Bureau began receiving numerous letters from Members of the Congress requesting information about AD–X2. In general, these letters were instigated by various distributors of Pioneers, Inc., through writing to their Senators. During the last half of 1951, 28 Senators and 1 Congressman transmitted queries about this material. In 10 cases, second letters were involved, and in 1 case, a third letter was received during this period. To facilitate the handling of these inquiries, the Bureau prepared in August 1951 a mimeographed leaflet touching on many of the common points in the letters. An indication of the motivating force behind this

letter-writing campaign can be seen from the following excerpt from a nine-page memorandum of August 21, 1951, sent from Battery AD–X2 Plant No. 236 to "all distributors, prospective distributors, and interested parties" on the subject National Bureau of Standards versus Battery AD–X2:

> We are now trying to bring to bear sufficient pressure to cause a Senate investigation of the National Bureau of Standards. We certainly have reason to believe that an investigation and perhaps a shakeup are in order. A few days ago, about the time that all distributors of Battery AD–X2 were writing their Senators, Dr. Edward U. Condon, for many years the Director of the National Bureau of Standards, suddenly resigned. We believe that this is significant and we like to believe that we had something to do with the resignation.

Most of the letters from the Congress were routine memoranda transmitted with the letters they had received from distributors in their areas. Others suggested the desirability, if possible, of the Bureau's making additional tests in order to settle the controversy. For example, the following request was received from the then Senator Nixon in February 1952:

> On January 24 you forwarded a copy of your reply to Mr. Jess M. Ritchie, president, Pioneers, Inc., with reference to the controversy existing on the testing of battery additives.
>
> As you will recall, Mr. Ritchie is the manufacturer of AD–X2, which he contends has been under condemnation by certain publications of the Bureau of Standards.
>
> It is my understanding that essentially the arguments put forth by Mr. Ritchie are, first, in the testing of selected battery additives, including AD–X2, the tests are not conducted under conditions that exist in actual practice; second, that in proclaiming the nonutility of battery additives based on these tests, AD–X2, to say the least, is indirectly condemned.
>
> The evidence, as I see it, is conflicting. On the one hand, there is a history of a successful use of this product over a substantial period of time and on the other, repeated tests that result in unfavorable decisions.
>
> In view of the extensive correspondence and discussions which have taken place as a result of these claims, it is my desire to resolve this disagreement once and for all. Therefore, I would appreciate your advising me of the methods which might be pursued to conclude this controversy in a manner which would convince any reasonably minded individual.

In March 1952 the executive director of the Select Committee on Small Business of the House of Representatives made the following request:

> This is in further reference to the complaint of Mr. Jess M. Ritchie, president, Pioneers, Inc., Oakland 12, Calif., relative to the refusal of the Bureau of Standards to approve his battery AD–X2.
>
> Because of the claims of Mr. Ritchie and the evidence of wide acceptance of this product, I am requesting that you make a new test of his product and submit a report on specific results of your testing.

As a result of interest of the Members of the Congress and also as a result of communications I had been having with Mr. Ritchie since December 1951, I agreed in May 1952 to run a new series of tests on Battery AD–X2, using a test procedure which Mr. Ritchie guaranteed would demonstrate the merits of his product. One of the major claims made by the distributors of AD–X2 in their letter-writing campaign to the Congress was that the testing procedure which had been used by the Bureau was not suitable to disclose the merits of the battery additive. Although I had no reason for questioning the adequacy of the test procedures the Bureau had used previously, I had hoped that by using a procedure described by him, the matter could be settled decisively for all concerned. A report describing the testing procedure

and the results obtained therefrom had been furnished to members of your committee.

An essential feature of this test which was carried out in June 1952 was that the batteries which were used for the test were to be disassembled and inspected by Mr. Ritchie or his representative and returned to the Bureau as suitable for complying with the objectives of the test. This was done by Mr. Ritchie and Mr. F. A. Harrel in the latter's battery shop in Arlington, Va. Mr. Ritchie did say that these batteries were not as badly sulfated as he had hoped, but that he did believe them suitable for the test. Most certainly the test would not have been conducted if he had not given such assurance.

Incidentally, the batteries were obtained from another Government agency as nonusable batteries and the representatives of this agency told representatives of the Bureau that they had not made prior unsuccessful attempts to charge the batteries. There was definite evidence when the batteries were disassembled and inspected that prior attempts had been made to charge them. This was concurred in both by the Bureau's representative and Mr. Ritchie. All of these batteries took a good charge, and there was definitely no superiority in the performance of the treated over the untreated batteries.

Here I believe that it is important to point out that had we put AD–X2 in all of the batteries rather than in just half of them, we would have duplicated the experience reported by most of the proponents of AD–X2. Here was a group of batteries which a prior owner had claimed would not take a charge. AD–X2 was put into one-half of them, and they took a charge. However, nothing was put in the remaining half, and they also took a charge and performed just as effectively as the treated batteries.

Some minor deviations were made in the testing procedure in the interests of expediting the test and insuring uniformity in the handling of the treated and untreated batteries. Most of these deviations involved technical considerations, but which could not conceivably make any difference in the outcome of the tests. In any case this is a point which the National Academy Committee is qualified to settle very promptly. In the test there were two groups of treated and untreated batteries.

In accordance with Mr. Ritchie's specification one group was to be examined visually and manually for the physical condition and appearance of the battery plates after the charging process was completed. The other group was to be tested for electrical capacity. For the group which was to be subjected to visual inspection, Mr. Ritchie claimed, for the treated batteries—

> The paste will be found to be soft and porous, and the active material in both the positive and the negative plates will be found to be in firm contact with the grids. There will be little peroxidization of the grids in the positive plates. There will be no warping or buckling of the plates and little shedding. The overall appearance of these batteries will indicate many months of useful service.

He claimed that for the untreated batteries:

> It will be noted that the positive grids are largely, if not entirely, peroxided out in the positive plates and that the plates will disintegrate under pressure and twisting. The active material in the negative plates will be found to be pried loose from the grid which will cause it to be chunky and sandy. (The plates may or may not be warped.) Shedding of the active material from the

plates will be considerably heavier than in the treated batteries. The condition of these batteries, if they were truly sulfated at the beginning, will show that they have little, if any, life expectancy, or they may be inert.

The attempt to verify these claims was made by a group of judges, including Mr. Ritchie and an assistant of his. None of the judges knew which plates came from treated and which from untreated batteries; they were asked merely to compare the plates and to rate them. None of the judges, including Mr. Ritchie and his assistant, was able to tell any consistent difference between the treated and untreated batteries.

Also in the group tested for electrical capacity there was no consistent or significant superiority of the treated over the untreated batteries. It is important to emphasize that in this series of tests the personnel conducting the tests did not know which batteries were treated and which untreated. This procedure provided a very effective means of insuring complete objectivity in running the test because if, by any remote chance, bias happened to be present on the part of an observer he would not know where to place his bias. Criteria for the modern design of experiments strongly recommend such a procedure whenever possible. After all the observations were taken both on the group of batteries for electrical tests and the group for visual inspection of the plates, the information was turned over to the Bureau's statistical engineering group, previously mentioned. These analysts were first directed, also without knowledge as to which batteries were treated, to look for evidence of two groups of batteries with distinct performance characteristics. Had the additive produced a real effect on battery performance, this would have been possible. When no pattern of this sort developed, the analysts were next provided with the information as to which batteries were in each two groups, but not told which group was treated. After analysis showed no significant difference between the two groups they were told which group had been treated and they proceeded with the preparation of the report.

A report on the results of these tests was submitted to the Small Business Committees of the House and Senate, and to other Members of the Congress who had been interested in the matter. Mr. O'Connor of your committee had requested that we make every effort to expedite the report and as a result it was distributed before a sufficiently thorough check had been made for transcription and typographical errors. These were checked later on a low priority basis and in September correction sheets covering the errors were sent to all recipients of the report. It should be noted that the errors were all trivial in nature and in no way modified the conclusions of the report.

We had fully hoped that this report would dispel all doubt as to whether battery additives of sodium and magnesium sulfates were beneficial to the operation of lead-acid storage batteries. This, however, proved to be a false hope since the proponents of AD–X2 began looking for minor flaws in the report and the testing procedure, ignoring the major conclusions of the report. As a result of the dissatisfaction on the part of the proponents of Battery AD–X2, Mr. O'Connor asked me later in the summer if we would be willing to run still another test. I informed him that we would attempt to run one under two conditions, first that it be designed to establish some pertinent

factor not included in the tests run the preceding June, and second, that Mr. Ritchie would furnish for the tests batteries which would not take a charge. Also during this period we had frequently pointed out that if the claims made for the Battery AD–X2 were true then it certainly should be possible to relate these claims to some pertinent phenomena which could be consistently measured and reproduced in the laboratory.

As a result of these discussions with Mr. O'Connor, a meeting was set up at the Bureau late in September to discuss possible future tests and also to hear reports from Dr. Harold Weber, of the Massachusetts Institute of Technology, on an effect he had found due to the introduction of Battery AD–X2 in a storage battery. No definite conclusions were reached at this meeting about subsequent future tests, although the possibilities of carrying out additional tests both at the Bureau and at MIT were discussed. It was, however, generally agreed that the possibilities for additional tests would be further pursued and also that Dr. Weber would furnish the Bureau a copy of his test results and of the experimental procedure by which they were obtained. Following receipt of this information the Bureau's statisticians were to give Dr. Weber an estimate of the number of samples necessary to establish definitely the existence or nonexistence of the effect reported by him. It should be noted that the effect reported by Dr. Weber was not observed under normal operating conditions but only when the normal electrolyte in the battery was dumped and replaced with a very dilute solution of sulfuric acid. Specific information as to Dr. Weber's testing procedure and results was not received by the Bureau until the MIT report was released by the Senate in December 1952.

At the September meeting there was some discussion about Bureau participation in MIT tests if such tests took place, but no definite decisions were reached. When the Bureau was informed that MIT was planning to make tests and invited to have observers present, it was concluded after some serious deliberation that it would be better if the Bureau did not participate in these tests. A major factor influencing this decision was Mr. Ritchie's attitude toward the Bureau and Bureau personnel. He stated emphatically at the September meeting that he would believe no results which were not favorable to his product and that he did not believe Bureau personnel could be depended on to give a fair test. In our desire to bring this controversy to a satisfactory close, we concluded that it would be better if MIT carried out its tests completely independently.

Following receipt of a report of the MIT tests a new series of tests was started in the Bureau in an effort to determine the reproducibility of the MIT test results and their applicability to normal storage-battery operation. The major results of these subsequent investigations were incorporated in a report made to the House Interstate and Foreign Commerce Committee on February 10, 1953. This latter committee has legislative jurisdiction over the functions of the National Bureau of Standards and in connection with a review the committee made of the Bureau's functions in February, this report was requested by the chairman of the committee. A major conclusion of the Bureau's investigations with respect to the effect reported by MIT is that the effect is observable in the batteries only with

electrolyte of extremely dilute acid concentration, so dilute in fact that it appears to be of no significance whatever in normal storage-battery operation.

Subsequent to the preparation of the report for the House committee, Bureau scientists sought to find more information as to the basic mechanism of the effect reported by MIT. These subsequent investigations have shown very definitely that at extreme acid dilutions, as well as at normal acid concentrations, the addition of sodium and magnesium sulfate mixtures inhibits the charging process by a small but definitely measurable amount. Thus it now appears that these mixtures inhibit rather than assist the reduction of sulfation in lead-acid storage batteries, although in normal operation the effect is so small as generally to be nonobservable. The effect reported by MIT is one of enhancing the discharge of the battery at extremely dilute acid concentrations. Thus, under these unusual conditions the additive inhibits the charging process but so facilitates the discharging process that there appears to be a gain. This apparent gain, however, is a delusion because it is encountered only in the part of the discharge process where there is insignificant useful energy left in the battery.

These later results of the Bureau together with its prior tests on AD–X2 have been summarized in a detailed report which will be made available to the committee set up by the National Academy of Sciences. The report could also be made available for the record of this committee if the chairman so desires.

The Bureau's experience with battery additives is not unique, since other laboratories both within and without the Government have also investigated them and for the most part as far as we have been able to determine, arrived at similar conclusions. I believe your committee is familiar with most of these other investigations since many of them were criticized in your release last December. I do not believe it appropriate for me to comment on the work in these other laboratories. Rather, I believe that if the committee is interested, it might call individuals responsible for these other tests and have them tell you about them here.

In conclusion. I would like to emphasize that throughout the period of its experience with battery additives, the Bureau has been motivated by one major purpose: the determination of scientific information. In other words, we have been primarily concerned with determining the measurable effects produced by the addition of these agents to the electrolyte of the battery, and relating these measured effects to battery performance. We would welcome the discovery of any phenomena which would clearly and unmistakably improve storage-battery performance. Our work with battery additives has, almost in its entirety, been done as a service to other agencies of the Government. Most work of this sort is considered a chore. We do not seek it but we do welcome the opportunity to be of service. Furthermore, we recognize that the Bureau is not infallible. We have made mistakes in the past and expect to make mistakes in the future. It is, however, important that when mistakes are made that we correct them promptly and take measures to insure that similar mistakes do not occur again. If we did not remain open-minded to the correction of past errors and to the acceptance of new ideas, we would immediately lose that objectivity which is necessary to the vigorous and healthy operation of any scientific laboratory.

We at the National Bureau of Standards are hopeful that the investigations of this committee and of the National Academy Committee will settle this matter conclusively and finally. We have tried to the best of our ability to be thorough and accurate in our studies. If, however, these investigations develop any scientific or technical information that is pertinent to this matter and which we have overlooked, we will have no hesitancy in considering the new data and amending our conclusions if these new data provide a sound scientific basis for such action. Thank you.

The CHAIRMAN. Dr. Astin, how long a period of time was required to run the test on that group of batteries that was delivered to your laboratory for the purpose of the test?

Dr. ASTIN. I think the charging period was about 4 to 5 days, and then there were a similar number of days on the discharging period. It was the better part of 2 weeks for the actual laboratory investigations.

The CHAIRMAN. But you never went out in the field or put a battery in the field under normal conditions and then watched the result of that battery over a period of 18 or 20 months or the normal life of the battery?

Dr. ASTIN. That is correct.

As I explained in my general statement, Senator, the custom is to resort to a field test after you have something you want to prove. In field tests the variables are much harder to control—that is, take the case of 2 automobiles in which the battery of 1 is treated and the battery of the other untreated. I think we are all aware of the fact that unless very rigorous control is maintained the environment or conditions—exposure conditions—to which the two automobiles would be subjected would vary appreciably. Those variations could very likely affect the performance of the battery so if one ran a field test it would probably take about 50 cars to get a good sample, and then one would have to provide periodic checks on the conditions of the battery and make some effort to insure uniformity in their operation, and it would also, of course, take much longer, and we have not run a field test because we don't consider it necessary. We have considered——

The CHAIRMAN. The only reason I asked this question, Dr. Astin—and I, not being a battery expert, therefore, cannot speak from any knowledge of experience, and not being a chemist I have absolutely no knowledge of what any chemical compounds might or might not do to a battery cell—but in the period of 2 weeks' time there was a week of charging and then a week of discharging—that would not be too great a length of time.

Of course, to a chemist and those who would understand all the functions of that chemical compound, I would imagine that you could determine by all your technical devices as to whether there was any deterioration greater in the cell of a nontreated than that of a treated, but 2 weeks is not a long time for a period of charging for 1 week and of discharging for another week, whereas the life of that battery in the field might be 18 or 20 months or 2 years, and I have learned from experience in personally caring for batteries that they probably would run 3 years.

Under those circumstances do you think an additive might possibly show some beneficial effect if it was in the field under the normal

general usage? The only reason I ask that question, Doctor, is that here on the table, between you and me, are copies of purchase orders from one firm over a period of several years. We, being practical-minded individuals, know that there would have to be performance experience that would indicate that it was beneficial or no man would be foolish enough, operating a fleet of motors, to continue purchasing the additive. That is a disturbing factor that I have been faced with throughout all this controversy.

I inherited the controversy. I was not aware that there was a controversy between the Bureau of Standards, the Small Business Committee, or Mr. Ritchie, until I returned to Congress the first of the year and, as a member of the committee, I was given a report about it. Then, when I assumed the chairmanship of this committee, I was faced with all of the embarrassments and the problems in which the question involved the committee.

When I examined the purchasing orders—and knowing that the American businessman is not fooled very often—you can fool him for a little while, but you do not fool him for very long—I realized no man operating a fleet would go back and pay $3 to condition a battery when the actual cost of the battery did not represent $24 to him if he was buying it wholesale.

Now, those are the bare positive facts with which we are confronted, and it is facts that I am endeavoring to uncover by these hearings. That means more to me than a technical test of a group of chemists standing over a bench in the laboratory where you can say that this did not break down and it did not have the effects that Mr. Ritchie said it would have.

I look at the businessman who had to spend the money, and if he has used that over a period of 3, 4, or 5 years, that man knows whether he got $3 worth or whether he did not. That is the factor with which you and I have to concern ourselves.

Dr. ASTIN. I can see, Senator, that that problem is one that would give you concern. However, we have taken the point of view that if the material performance does anything useful in the operation of a battery, then we should be able to relate it to some performance characteristics that can be measured. That has proved completely fruitless, I mean any pertinent effect, I should say.

The CHAIRMAN. Doctor, I want to believe in the Bureau of Standards.

Dr. ASTIN. I think I might give you some hints as to some of the possibilities as to why there are satisfied users, and I have no doubt that there are.

In the first place, most people are not battery-conscious; most people don't take care of their batteries. Other people will turn in batteries long before the useful life of the battery is up, and just in the case of insurance.

Supposing a person buys a battery that has an 18-month guaranty. At the end of 15 or 16 months he will say, "The guaranty period on this battery is just about up. It might go bad on me; I don't want it to go bad, and I will turn it in."

If, however, he had put in some material which was expected to prolong the life of the battery, I think the chances are that he would keep it until the battery went bad, so that I feel that there is sort of

a psychological factor that may account for the apparent advantage or, let us put it this way, account for the satisfaction of users.

The CHAIRMAN. Dr. Astin, if I may interrupt at that point, that is absolutely true if a person has the means, so that $24 does not mean anything to him. But, assuming now, as another example, that a man had used the battery and the battery failed him in the car, and he took it to the garage and the garage said, "Well, the battery is rather weak, and we will give it a hurried charge, and I guess it will take care of you for the time being," and then somebody made mention of this additive, and he poured that additive into each cell, and they added enough water to fill the cell, and then they give that hurried charge, and the man went on for another 6 months and never had another problem, would that be conclusive evidence that the compound had something to do with the battery?

Dr. ASTIN. No.

The CHAIRMAN. Do you disagree?

Dr. ASTIN. You would have to have two batteries just alike.

The CHAIRMAN. No, Doctor. Here is a battery that had lost its ability to perform. A competent battery man, who had subjected the battery to the instrumental test, says, "Well, your battery is pretty weak; there isn't much left in it, but maybe if you can't afford to make the exchange, we will give it a quick charge, and it will probably carry you along." Then through some happenstance somebody talked to him about the AD–X2 and they made the application, and the battery continued to perform for many months, and perform satisfactorily. What would you want to do? Tell that man that he should not use it, it was fraudulent; or let the man go on and buy the compound and revive his battery for 6 months?

Those are the commonsense problems that this committee is faced with, and we do not know the answers; and if we ask you questions, we are not interrogating you to destroy the potency of your statement, but we are trying to comb for the last morsel of evidence as to whether this man should be denied the right to package and sell the product or whether he should be privileged to sell it.

Now, that is the whole meat of the nut, as far as I am concerned. I just want to be able to say in good conscience, "We have done everything in the world to permit a small-business man to continue in business, and we cannot find a shred of evidence from the man who has used the product that he felt he had been defrauded."

I am putting it to you just as a layman, and you are the scientist, and I want to believe in the Bureau of Standards, and we all do. We would not condemn the Bureau of Standards, not for one minute; at least, I would not. But the proof of it lies in that bundle of purchase orders that have been repeated and repeated over a period of many years. The old saying is, "You can fool a man once, and that is your fault; if you fool him a second time, it becomes his fault." Evidently this man had been continuing to purchase something that you said was absolutely worthless over a period of almost 5 years and still believes in the product.

Dr. ASTIN. It is difficult to answer that question, Senator, but one cannot ascribe a particular result as being due to a particular action unless you know what would happen if that action had not been performed.

Well, now, suppose you have a cold and you have it a couple of days and you take some aspirin and you are better the same day; did the aspirin do it or would you have been better anyway? That is a very homely example.

The CHAIRMAN. That is right, Doctor.

Dr. ASTIN. Now, this type of thing of a controlled experiment is very difficult for nontechnical people to appreciate. I think one of the best examples I can give to you is Sinclair Lewis' Pulitzer prize novel, Arrowsmith.

The CHAIRMAN. Sinclair Lewis was a Minnesota man, and I knew him personally. I have been in his home. I have dined with him. He was a great writer. I would like to have him present right now, sir.

Dr. ASTIN. Well, if you recall that story, it is about a scientist who develops a cure for some disease—I forget now what it is—and he thinks it is working, but he is not sure, but enough other people believe that the cure is working so that they want him to give the treatment to all sick individuals, but the scientist is more concerned with establishing his point, and he gives a treatment to only half of them. You see, that is the only way that you can prove something of this sort. You have to keep a control.

The CHAIRMAN. Dr. Astin, since this question came up, and for the sake of a sort of amusing scientific argument, I saw a paper where two scientists had debated at great length on the question of whether boiled water would freeze quicker than unboiled water, and it was amusing to me to read the scientific language used in the debate on the simple question of whether water boiled would freeze more rapidly than water not boiled.

If the two scientists could use up more than a large printed page in a debate on that question, I can readily see when we get down to the question of a compound in a battery where I would be trying to argue with a scientist. I would be defeated before I uttered the first word.

But the simple truth of the question is that if a good, hard-fisted businessman has used the product in a fleet of motors and in the batteries serving those motors over a number of years and is fool enough to come up and place orders month after month, what is the matter with him? Or otherwise, what is the matter with the Bureau of Standards' test?

Now, that is the question, sir.

Dr. ASTIN. The man with his fleet of cars might have some real data to debate on if over a rather long period of time he put the material in half the batteries of his fleet and took pains to make sure that each half of the fleet had roughly the same use conditions, and then checked them monthly. On that basis, it would mean something.

The CHAIRMAN. Dr. Astin, that was the basis of why I asked you whether you had actually run a field test, where the test was run over the length of the life of a battery under normal field conditions. You stated that no such field test was made by the Bureau of Standards.

Now, the other question that the evidence has disclosed to us about such a fleet operator is that if they had a cold financial sheet of what it cost them to maintain the battery service of their fleet of motor units over a period of years and if they made the application and they found that after they commenced to use the compound, their actual dollar cost of servicing their fleet unit with batteries was materially reduced, that in itself is the same argument that I must be faced with

when you say "if he took half of his batteries and serviced them with a compound and then took the other half and did not service them, and then made his comparison." All I can do is to look at the financial sheet of a man who had a record of what it cost him to service that fleet of batteries over a period of years and what the cost was after he used the compound.

Those are the cold facts which I can look at and understand, but I do not know a blessed thing about it when you start talking about the technicalities of a 2 weeks' laboratory test. I cannot get as much convincing argument out of that type of test as I do out of the cold, factual information of the costs or the return orders of an operator who knows when he is being taken and when he is not being taken.

Now, I do not want to debate. I am now going to yield to Senator Sparkman.

Dr. ASTIN. Could I try and answer your question a little further?

The CHAIRMAN. Yes.

Dr. ASTIN. In this case of the experience of the fleet operator, I would be very skeptical that his treatment of the batteries was the same after he started using the treatment that he gave it before. I would think that if he began to worry enough about his battery problem to start using the treatment, he might also at the same time start giving his battery a little better attention and care. And the apparent gain in life might well be due to the latter, and not the former.

The CHAIRMAN. Dr. Astin, that is a positive certainty, that he might have done exactly that. But an operator of a fleet of gravel trucks and a dragline, where he has a great number of men and a common goal, whether they are on a bulldozer or on a truck, or what they are on—if they are skilled in their profession, he may have a crew of men this month and for an unknown reason he may have a 50 percent turnover in the number of operators on those machines, and as an individual sitting down in an office and only coming on the job occasionally and relying on his foremen, he would not have a revolutionary change in the type of care of those batteries, because he is not personally doing it. You or I could personally do it with our automobile battery, but no man operating 25 or 50 or 75 units is going to give it that individual, personal care, you see.

I do not want to be argumentative, and I do not want to monopolize the time of this committee. Therefore, Doctor, I will just stop at this point and turn to Senator Sparkman, who was the chairman of this committee when the investigations were first commenced last year.

Senator Sparkman.

Senator SPARKMAN. Dr. Astin, I do not care to continue the line that Senator Thye was questioning you on there to any great length, but I must say, to a layman, it appeals greatly, that is, the practical application of the thing for people who are trying to save money and are not trying to buy something that is useless. Now, I saw this statement sometime ago, that Secretary of Commerce Weeks said that he had a $1,350 battery that had run down. The battery people told him that it was no good, and they were about to replace it. In fact, they were there to replace it, when a distributor of this AD–X2 happened to find out about it, and told him that he would treat it, I understand, on the condition that if it worked out, he would pay him $150. If it did not work out, he would pay him nothing.

He did treat it, and I understand that Secretary Weeks has said

that he paid him the $150, and it has been operating ever since. And that has been over a year's time, or about a year's time.

Now, the repetitions of cases like that are pretty potent as argument to a layman. Would you care to add anything further, or does the same thing that you have said on the fleet of trucks apply to that?

Dr. ASTIN. Essentially it is a similar answer that I gave to the chairman. This would mean anything. This experience of Secretary Weeks' company would be conclusive only if controls were run, and from my own experience of the lack of effect of these materials on the batteries, I would be willing to bet that if everything that was done in restoring this battery had been done except for adding the additive, they would have gotten the same result. It is one of those things that you can never prove.

Senator SPARKMAN. You say, "everything except the additive." What else was done?

Dr. ASTIN. I do not know. It was charged, most certainly. It must have been charged.

Senator SPARKMAN. Yes; after the additive was put in it, I assume.

Dr. ASTIN. Now, I gave you in my prepared statement the experience we had in the tests of last June. These batteries had been acquired by us as worthless batteries. But they were not, and I am inclined to think that Mr. Ritchie and his organization know pretty well how to take care of batteries, and they do a great deal in a reconditioning line. That is, their charging techniques are probably designed to really make a battery take a charge. But the additive itself, we do not see how it could have any effect at all.

Senator SPARKMAN. From his testimony, I gather that he claims that this has a kind of cleansing effect. Is that helpful in taking care of a battery?

Dr. ASTIN. I do not see any way that it would have a cleaning effect; no, sir.

Senator SPARKMAN. I used the term "cleansing." He did not use that. I think he was talking about removing sulfation, was he not, and reducing sediment?

Dr. ASTIN. We have found that it has no effect of that sort.

Senator SPARKMAN. Now, when you were telling about those batteries that you bought from a Government agency, that had been discarded as being no good, the thought occurred to me, why did you not have some method of checking for yourself to determine whether or not those batteries were good? In other words——

Dr. ASTIN. Well, the method that we would have used to check to see whether they were any good was essentially the charging procedure that was given them during the test, and they were good.

Senator SPARKMAN. Yes. But half of them were treated with additive and half were not.

Dr. ASTIN. That is correct.

Senator SPARKMAN. I suppose that it is conceivable, although improbable, that the very half that were treated may have been bad and the others may still have had some good in them. I hope you understood; I said it was improbable, I suppose.

Dr. ASTIN. One hopes to avoid anything of that sort happening by using a fairly large sample. It is, however, possible to make pretests on batteries before running an additive test to insure some reasonable uniformity in their quality. We have done it both ways.

Senator SPARKMAN. By the way, I understand that in the original test on which the fraud order was based, you used only 2 batteries, 3 cells treated, and 3 untreated. Would that be enough upon which to base a decision; do you believe?

Dr. ASTIN. No. More batteries were used than that on the test for the Post Office Department.

Senator SPARKMAN. This is a Bureau of Standards statement before the Interstate and Foreign Commerce Committee. It says, "Six cells, three treated, three untreated, were used for the AD–X2 test." It is on page 15 of the statement before the House committee of February 10, 1953.

Dr. ASTIN. I do not have that handy.

Senator SPARKMAN. Here it is. Would you like to see it?

Dr. ASTIN. Yes, sir.

This is referring to Circular 504, and not the——

Senator SPARKMAN. I know. But you said that it was the test for AD–X2 upon which that was based.

Dr. ASTIN. No. There was a specific test run for the Post Office Department and for the Federal Trade Commission, in each case using samples supplied by them. And for the Federal Trade Commission, six 3-cell batteries were used; for the Post Office Department, fourteen 3-cell batteries were used.

Now, for the data which were given in this Circular 504, it is true, only two 3-cell batteries were used. But Circular 504 was a general publication on battery additives of the sodium and magnesium sulfate type. We had had, as I explained in my general statement, experience for many years preceding on mixtures of this sort. A chemical analysis showed that this particular sample consisted primarily of sodium and magnesium sulfate, and, as I recall, there were 5 or 6 other samples included in this Circular 504. And all of them behaved substantially the same, and because of the similarity of materials, none of which showed any performance, this was considered quite an adequate sample for that purpose.

In other words, any group of statisticians analyzing the data for variations, I am sure, would conclude, with respect to the conclusions given in Circular 504, that the samples were adequate.

The CHAIRMAN. Doctor, for the information of all of the committee, here is the Circular 504, which is referred to, and this became the document upon which the Post Office Department determined the fraudulent order.

Dr. ASTIN. No, sir.

The CHAIRMAN. It was not?

Dr. ASTIN. No, sir.

The CHAIRMAN. Not on 504?

Dr. ASTIN. No, sir.

The CHAIRMAN. Or any of the evidence in 504?

Dr. ASTIN. I don't know whether the Post Office people gave any weight to the evidence in there or not. But for the Post Office Department, we ran a specific test which had a total, according to my notes, of 14 batteries.

The CHAIRMAN. Fourteen batteries?

Dr. ASTIN. Yes, sir.

The CHAIRMAN. But this was a circular to which the Better Business Bureau also referred, was it not?

Dr. ASTIN. Yes, the National Better Business Bureau.

The CHAIRMAN. It was an official document of the Bureau of Standards that condemns any battery additives?

Dr. ASTIN. No; it does not condemn them.

The CHAIRMAN. But it finds that they are of no benefit?

Dr. ASTIN. It says that there is no value to the battery additives of the sodium-magnesium-sulfate type.

The CHAIRMAN. That is correct. If that is not a condemnation, then I want to get that clear.

Dr. ASTIN. That was merely presenting the results of a technical investigation.

The CHAIRMAN. Could they by any chance have something in that compound other than the two salts that have so commonly been referred to here in the discussion? You know, some important discoveries have been by accident.

Dr. ASTIN. Yes.

The CHAIRMAN. And even back in the Biblical days, you know, they found how to separate butterfat from milk by the mere fact that a skin of milk was thrown over an elephant's back, and the juggling of that elephant finally separated the butterfat, and that is how they found how to separate the butterfat and get butter.

Now, is there a possibility that these men who developed AD–X2 by some mere chance, found, by adding something into the common salts that have been referred to, that they came up with something that had a beneficial effect that all the other additives did not? Now, that is a possibility; is it not?

Dr. ASTIN. It might be a very remote possibility. But if that were a fact, I mean, if there were some secret ingredient or mysterious ingredient in it which gave it superior properties, then that material should behave in a storage battery differently from other mixtures of sodium and magnesium sulfate. And it does not. So from our observations, there is nothing in this material to make it behave differently from plain, ordinary glauber salt and epsom salt.

The CHAIRMAN. Now, sir, you have taken me out into such deep waters that it is above my head, and I will stop on that point. Somebody has used the product and is quite satisfied that it is all right. That is evidenced by all those sales orders.

Senator SPARKMAN. Dr. Astin, let me say this. I think the chairman gave you this same assurance. I certainly do not want to do anything or to be a party to any action that destroys the integrity of the Bureau of Standards. I want to see the Bureau of Standards maintain the purpose for which it was organized. I think it is our intent to be just as objective as we possibly can in these queries.

By the way, let me say this. I was chairman of the committee when this matter came up. I have no apology to offer for our committee's having undertaken it. I think we would have been neglectful of our duty if we had not.

You point out that some 28 Senators had interested themselves in it. Those same Senators were calling upon a committee that had been set up in the Senate for the purpose of protecting the interests of the small-business man, to intercede in behalf of this small business. We handled it as a routine matter. We have literally hundreds of these cases throughout the year, and it was handled by the staff as a routine matter. I think we may be able to arrive at the truth,

whatever it may be. It certainly is not my purpose, and I am sure not the purpose of any member of this committee, to do anything that would impair the efficiency or reflect upon the integrity of the Bureau of Standards or on your administration of it.

Now, about the number of cells that were used: In the MIT test, they used 56 cells. I may be mistaken in this, but I was under the impression that the Bureau had directed some criticism to the test by MIT saying that it was not sufficient, and yet it seems to me that they used more cells than the Bureau ever used.

Dr. ASTIN. No. We did not criticize the size of the sample in the MIT test.

Senator SPARKMAN. What was the inadequacy of the MIT test?

Dr. ASTIN. The MIT tests were inadequate, from our point of view, in that none of them were made with normal acid solutions, according to my recollection. In all cases, they dumped the acid out of the batteries they were using. And in part of them they made subsequent tests with plain distilled water as the electrolyte, and in other tests it was a very dilute solution of sulfuric acid, which is the normal electrolyte, but much diluter than one encounters ordinarily in the regular operation of a battery.

Now, for that reason, the results are not directly pertinent to normal battery operation, and one then has to extend the effect, and as I indicated, we have gone into this very thoroughly. We can reproduce an effect where there appears to be an advantage, but the advantage disappears or is completely nonexistent as soon as you increase the concentration of the acid to the range you have to have it in in order to get adequate energy out of a battery.

Senator SPARKMAN. As a battery is used, does the liquid in it become more dilute, or does it remain the same, or does it become more concentrated?

Dr. ASTIN. It varies. If one starts out with a fully charged battery, as the electrolyte you have a sulfuric acid solution of the density of 1.280. One electrode of the battery is made of lead and the other of lead peroxide. Now, as the battery discharges, as it supplies energy, the sulfuric acid in the electrolyte is converted at each electrode to lead sulfate. That is, the lead on the negative is converted to lead sulfate, and the lead peroxide on the positive is also converted to lead sulfate, and the sulfate obtained for this conversion comes from the sulfuric acid in the battery electrolyte.

This means that as the battery discharges, there is less sulfuric acid in the electrolyte, and its density consequently decreases, so that when a battery is fully discharged, the density is somewhere, maybe, around 1.150, commonly called eleven-fifty, and then the charging process merely reverses.

Now, the acid concentrations or densities which were used in the MIT report were substantially below the density at which a battery is normally considered fully discharged.

Senator SPARKMAN. Does the battery take a charge better with a diluted mixture or with a higher concentrated mixture?

Dr. ASTIN. Yes, it will; a battery will take a charge more readily in dilute solutions than in concentrated solutions.

Senator SPARKMAN. Therefore, if you use—by the way, will it hold it as well?

Dr. ASTIN. Yes, I think it will also hold a charge better. As I recall our—yes, that is right. As the density increases, local action on the electrodes which causes self-discharge——

The CHAIRMAN. Senator, might I interrupt for just one point on that?

Dr. ASTIN. Yes.

The CHAIRMAN. Why don't they dilute the acid content of the battery at all times if they get a better reaction?

Senator SPARKMAN. You guessed my next question, Mr. Chairman.

Dr. ASTIN. The reason for that is that you would have to have a larger battery. There is a finite amount of sulfuric acid in the elctrolyte between the plates of a cell, and in stationary batteries that are in laboratories, the acid density is much lower, and the lower density is used because the battery will last longer under those conditions.

We have out in our laboratories lead-acid batteries that we have had for 16 or 18 years, but most of them have lower acid concentration.

Now, if one is interested in saving space with a battery, and you get into this problem for aircraft batteries, then you will have less volume for the electrolyte, and it is necessary to use a higher density or a higher concentration of acid. So the various design criteria, depending on the uses to be made of the battery, influence the choice of the acid density where the battery will operate.

Senator SPARKMAN. I am a little puzzled about how the Bureau operates. My understanding is that it is primarily, if not exclusively, for Government purposes. How does a private concern get a test at the Bureau?

Dr. ASTIN. The only type of testing we do for a private concern is what we call calibration work. "Calibration" means that operation with respect to some measuring instrument which gives meaning to the scale or reading device on the instrument. For example, if one is interested in calibrating a yardstick, the calibration process consists in determining whether the interval between the 1-inch mark and the 2-inch mark is in fact an inch, or if it is not, how much it differs from it. That is what we mean by "calibration." That is the only type of service that we do for the public.

Senator SPARKMAN. How did this get before you, then? I understood you to say that the first test was made on the request of the Better Business Bureau——

Dr. ASTIN. No; no, sir. The first test—well, first we have been testing these things for many years. One for the Federal Trade Commission was tested back in 1924 or 1925. The AD–X2 test was run initially just to satisfy our own curiosity, because so much agitation has been stirred up about it. This was done starting in January of 1949. Then it was over a year later when the Federal Trade Commission asked us to make a test on this material.

Senator SPARKMAN. What was the test you referred to as being made at the request of, I think you said, the Oakland Better Business Bureau and Senator Knowland?

Dr. ASTIN. The interest of the National Better Business Bureau in the dissemination of information about battery additives was one of the factors that led to the preparation of this Circular 504. We made no test at their instigation. All we did there was make available to the public information we had acquired, because it was considered to be useful to the public, and we have always considered the National

Better Business Bureau as an organization well qualified to gage some of the interests and needs of the business community.

Maybe we were wrong on that, but we have always considered the National Better Business Bureau as a worthy institution. When they tell us that the dissemination of some type of information is important, then we are inclined to believe them.

Senator SPARKMAN. I do not want to carry this too far. But you referred to something, and I thought you referred to a test that was made at the urgent request of the Oakland Better Business Bureau and Senator Knowland.

Dr. ASTIN. Yes. Each of them requested that we carry out a test on AD–X2. The replies to each of them said that there was no need for the test to be carried out, citing, first, that tests were already being run by two military agencies, and also that we did not make a business of testing proprietary products for individual manufacturers. However, the Oakland Better Business Bureau sent on a sample of the material, which we retained, and it happened that just about a month after this, a test on another battery additive was started, and——

Senator SPARKMAN. You ran them contemporaneously?

Dr. ASTIN (continuing). And they were run together.

Senator SPARKMAN. Yes, sir. Now, Doctor, with reference to the National Better Business Bureau, I am not sure whether you were in here this morning when the criticism was directed at the Bureau of Standards because you furnished the National Better Business Bureau with information relating to battery additives in which the name of AD–X2 was used, although that was contrary to your regular practice.

Dr. ASTIN. That is correct. I was not a party to that decision, although I am inclined to think that I would have made the same decision. I believe it is a decision that could have gone either way, and might have been criticized either way. It was decided to allow the National Better Business Bureau to announce the fact that we had tested AD–X2 with negative results, because strong representations, so I am informed, had been made to the National Better Business Bureau that AD–X2 should be exempted from the general statements it had been making previously about battery additives and also that we had not tested AD–X2.

Both of these statements were erroneous, and we felt, and the Bureau felt, that in the interests of making the truth available, it should be disclosed that the Bureau had tested AD–X2. The Bureau itself, however, declined, then, to disseminate any information from its own offices, except the letter to the National Better Business Bureau.

Senator SPARKMAN. The request that came through the Federal Trade Commission—do you know the source of that request?

Dr. ASTIN. No, sir; I do not.

Senator SPARKMAN. Have you seen the copy of the letter the Association of American Battery Manufacturers directed to the Federal Trade Commission?

Dr. ASTIN. No, sir; I have not. I don't recall having seen that.

Senator SPARKMAN. What is that?

Dr. ASTIN. I don't recall having seen the letter you mentioned.

Senator SPARKMAN. That was dated March 10, 1950.

Have you seen the copy of the letter dated February 2, 1950, written to the Association of American Battery Manufacturers, Inc., by Key-

stone Batteries, in which they complain that AD–X2 is taking business away from them? It says:

> This is a serious situation. We know that we have lost a considerable amount of business for last month alone, and loss of business to large manufacturers must have run into thousands.

Then upon the basis of that, the Association of American Battery Manufacturers, Inc., to whom this letter was addressed, wrote to the Federal Trade Commission asking it to look into the AD–X2 matter.

I wonder if you are familiar with the letter from George W. Vinal—is that his name?

Dr. ASTIN. Yes, Vinal.

Senator SPARKMAN (continuing). Chief of the Electrochemical Section, Division of Electricity and Optics, dated June 22, 1949, written to Mr. K. B. Willson, of the National Better Business Bureau, saying:

> It has been our policy not to make any tests on commercial products—

regarding AD–X2, the letter is—

> until requested to do so by some Government agency which is interested in the merit of the product. If this matter is turned over to the Federal Trade Commission, it is possible we may be requested to make tests.

Dr. ASTIN. Well, I would say that that is just an expression of fact.

Senator SPARKMAN. You would say it would not be a suggestion as to procedure?

Dr. ASTIN. I hope it would not, because the testing of these things is an onerous task to us. We do not like to do it, and I do not know any member in the organization who would go out and solicit a job of this sort.

What was the date of this letter, sir?

Senator SPARKMAN. That is June 22, 1949.

Dr. ASTIN. Well, it was March, I believe, 1950, when the FTC made the request.

Senator SPARKMAN. I will admit that the request of the Federal Trade Commission is more nearly in tune with these two letters that I referred you to a few minutes ago.

Doctor, let me say to you that the principal complaint that I have heard about the Bureau of Standards, not relating to this case alone, but to other cases—and I must say in all frankness and fairness that we have had complaints from a good many small-business men from time to time to the effect that they were unable to get what they felt was fair treatment and proper treatment and proper consideration at the Bureau of Standards. The complaint that I have heard most, I will say to you in all fairness, is that the Bureau of Standards has its fixed standards, and it adheres to them without full regard to changes that may take place.

Now, I will say in connection with this AD–X2, the complaint was that every time a letter was written to the Bureau, back in the early days, the answer came back that this was tested back in 1931. I do not mean that literally. But a report, Circular 302, was it——

Dr. ASTIN. Yes, sir.

Senator SPARKMAN (continuing). Or a letter, or something like that that was issued in 1931 was sent out. And they seemed to have a hard time ever moving up toward 1950. Now, it may not have made

any difference, but, to the layman, sometimes it creates a feeling of futility.

Dr. ASTIN. I think, Senator, that you will find our staff as willing to accept a new idea as any group of scientists or engineers you can find. As a matter of fact, the acceptance of new ideas is one of the things we are trying to stimulate and encourage. On the other hand, any competent scientist is wary of every hair-brained idea, and a skilled scientist has to be able to distinguish between the two. Sometimes mistakes, of course, get made. An idea that might appear hair-brained might have merit to it, but those are rarities.

Senator SPARKMAN. Doctor, I have no interest in this matter except in a purely objective manner. Is there not some way that a conclusive test for the satisfaction of everybody can be conducted and conducted in such a way that there will be no possibility of a mistake?

Dr. ASTIN. I would hope that is what we were going to run last June, a year ago, but——

Senator SPARKMAN. That is when you used those 17 batteries?

Dr. ASTIN. Yes. It is possible that a special committee of the National Academy of Scientists will give you the answer to that.

Senator SPARKMAN. Now, are they simply going back to the 1931 circular, or Circular 504, or something like that, that has been done, or are they going to set up a test that will remove all of these obstacles? For instance, going back to this one of last June, I believe you said awhile ago that normally in testing a battery of this kind, you would test it first to see whether or not it would take a charge. Now, had that been done last June, it seems to me you might have had a conclusive answer to this thing.

Dr. ASTIN. That was not called for in the testing procedure Mr. Ritchie had prescribed.

Senator SPARKMAN. I know. But can't some procedure be prescribed not necessarily by Mr. Ritchie or by any individual, but perhaps by the committee that you are going to set up, or that has been set up, that will eliminate these possibilities of error?

Dr. ASTIN. I am certain that the National Academy can find a testing procedure which certainly would satisfy scientists and engineers. Whether it is possible to satisfy——

Senator SPARKMAN. Would it satisfy these——

Dr. ASTIN. Whether it is possible to answer this question about satisfied users without a field test, I don't know.

Senator SPARKMAN. By the way, I am glad you mentioned that field test, because I wanted to ask you a while ago, what about a field test? Can a field test be made?

Dr. ASTIN. Surely. A field test would be much more expensive. It would take longer to run, and the results would be subject to much greater error, because there would be a large number of new variables coming in in a field test that would not come in in a laboratory test, and these variables influence and reduce the accuracy of the conclusions that can be drawn.

Now, that is why I have not done a field test, because it would be much more expensive and time-consuming, and less conclusive.

Senator SPARKMAN. Thank you, Mr. Chairman.

The CHAIRMAN. Dr. Astin, the military did purchase quite a volume of this additive, did they not, over a period of several years?

Dr. ASTIN. It is my understanding that they did, yes.

The CHAIRMAN. And surely the military would have had a fairly good knowledge of operating costs and benefits derived from the additive, because there you would have definite supervision, and you would certainly have a field operation?

Dr. ASTIN. The only field operation I know of that was carried on by the military—and that was really too short to be completely conclusive——

The CHAIRMAN. How long a period of time was that?

Dr. ASTIN. Six months. This was, I think, carried out by the Detroit Arsenal in 1948. It yielded a negative result, and found no value for the material.

The CHAIRMAN. But then we might criticize the military for having gone on and continued to use it?

Dr. ASTIN. No. I think that there——

The CHAIRMAN. They continued to use it; did they not?

Dr. ASTIN. Not this particular group.

The CHAIRMAN. No. But others did.

Dr. ASTIN. As nearly as I can determine, the laboratory people, that is, the engineers in the military, wherever they have made evaluations of this, have rejected it. There are some instances of shop technicians who have used the material and liked it.

The CHAIRMAN. They liked it?

Dr. ASTIN. And they liked it.

The CHAIRMAN. And they were shop-experienced men.

Dr. ASTIN. I can say that they were experienced probably in handling batteries, but I would be skeptical whether they were experienced in evaluating and interpreting data. In other words, I think that the conclusion that they drew that the material was useful might be questioned.

The CHAIRMAN. There you have again, the Bureau of Standards' capacity for evaluating these things against the practical experience of those using the product in actual operation.

Dr. ASTIN. No, Mr. Chairman. There is a very serious difference, an important difference here. Whether it is a fact that the material helps or does not help in performance of a battery, that is one thing. We are confident we know the answer to that.

The other is: Does a man, a particular user, think it has helped him? Now, there are any number of factors which can influence a man to think the additive has helped him, when, in fact, it may not have.

Now, those are two different things. The latter one, we can just guess about. We are not skilled in evaluating that type of evidence. It is not scientific evidence. But we are skilled in the other. And I think that they are two quite different things. A man can think the material is helping him when in fact it is not.

The CHAIRMAN. Doctor, I have here a copy of a letter that was signed by H. A. Harvey, and it was addressed to Mr. Craig R. Sheaffer, Assistant Secretary of Commerce, and the date of this letter is May 21, 1953. There is one paragraph in this letter which I shall read:

> Chemical analysis of AD–X2 shows that it consists primarily of magnesium and sodium sulfates, like most of the hundred or more products with similar claims which have appeared on the market during the past 40 years. It is well

known to battery engineers that magnesium and sodium sulfate help to dissolve impervious lead sulfate which may render batteries inoperative as sulfated batteries.

Dr. ASTIN. That is contrary to our experience or any information we have been able to find in the scientific literature. In fact, that is the basis for the position the Bureau has had on battery additives since 1925.

The CHAIRMAN. This letter comes from the Auto-Lite Battery Corp., Niagara Falls division, Niagara Falls, N. Y., and Mr. Harvey is the vice president.

You see, in other words, that is their thought as a battery manufacturer. One thing that has disturbed me is the interest of the battery manufacturers in this question of AD–X2. That is the reason I read the paragraph out of this letter.

I am going to make this letter a part of the record.

(The letter referred to follows:)

AUTO-LITE BATTERY CORP.,
NIAGARA FALLS DIVISION,
Niagara Falls, N. Y., May 21, 1953.

Mr. CRAIG R. SHEAFFER,
Domestic Affairs, Assistant Secretary of Commerce,
Washington 25, D. C.

DEAR MR. SHEAFFER: As requested in your letter April 22, I offer the following comments regarding releases from the Department on the subject of Dr. Astin and battery additive AD–X2. The attitude of Secretary Weeks is highly commendable and the committee he has appointed to study the functions and operations of the Bureau of Standards should inspire confidence. An evaluation of the merit of additive AD–X2 under the auspices of such a committee should result in a fair appraisal, free of any suspicion of partisanship.

Chemical analysis of AD–X2 shows that it consists primarily of magnesium and sodium sulfates, like most of the hundred or more products with similar claims which have appeared on the market during the past 40 years. It is well known to battery engineers that magnesium and sodium sulfate help to dissolve impervious lead sulfate which may render batteries inoperative as sulfated batteries.

The formation of lead sulfate in a battery is an essential feature of the process of battery discharge. No lead-acid battery can give up its current without forming a proportionate amount of lead sulfate. This lead sulfate is converted back to the active materials of sponge lead and lead peroxide in the normal process of recharging the battery. If all or part of the lead sulfate is allowed to stand without charge for a considerable period due to failure to recharge the battery, the sulfate tends to change from the normal porous form into dense, hard sulfate which the electrolyte cannot penetrate, so the battery refuses to take a charge.

Under this condition, addition of potassium or sodium sulfate is helpful. It dissolves part of the lead sulfate and permits the electrolyte to permeate the mass so it will accept the charging current. There is no doubt that AD–X2, or any of the hundred other battery additives which have been condemned by the Bureau and the industry in the past, would have a beneficial effect under this condition. No doubt this accounts for the observation reported in the MIT investigation that sulfated batteries charged more readily with less heat on addition of AD–X2.

There would be no controversy among battery engineers as to the usefulness of AD–X2 in rectifying a condition of this kind. They would not use, however, a material of special secret composition, but ordinary Glauber's salts or Epsom salts, which are commercial sodium sulfate and magnesium sulfate. Usually, it is not practical to expend the time and effort necessary to correct a severely sulfated condition since the treated battery will be inferior to a new battery which can be purchased at moderate cost.

To claim that the addition of these salts is desirable in new batteries is something quite different. The salts would have the same action on normal sulphate produced every time the battery is discharged and thus remove from the plates

of the battery material needed in further cycles of charge and discharge. No Battery Engineer would recommend the use of such a material in new batteries, most of which will never arrive at the condition of harmful sulphation for which the salts might be beneficial. It is questionable whether the salts would have sufficient remaining solvent capacity in case the condition of harmful sulphate appeared later. Automobile batteries, for which AD–X2 is usually sold, usually fail from other causes than hard sulphation, in about this order.

1. Disintegration of grids.
2. Container failure.
3. Internal short circuit.
4. Loss of active material.
5. Separator failure.
6. Excessive sulphation.

The claim that because of the presence of mysterious trace elements additive AD–X2 functions in some manner quite differently from that of its two main ingredients will appeal to the credulous. I see no evidence in the test reports of any effect which would not be expected if these trace elements were absent. If further tests are made, I suggest that some batteries be treated with AD–X2 containing the claimed trace elements and others with a similar mixture free from them, with knowledge of which was the true AD–X2 withheld from the test personnel. A marked difference in the results with the two ingredients would refute or confirm the trace element theory.

The storage-battery industry has no special interest in AD–X2 or any other substitute electrolyte for batteries, except to protect their product against harmful practices which would injure the maker's reputation and to protect the public.

Mr. Jess M. Ritchie, promoter of AD–X2, appears to be an accomplished psychologist and politician. I am inclined to think that it is these qualities rather than the merit of his product which underlie the furor which he has caused with AD–X2.

Very truly yours,

(Signed) H. A. HARVEY,
Vice President.

The CHAIRMAN. Senator Schoeppel, have you any questions?

Senator SCHOEPPEL. Yes, sir; I do have.

Dr. Astin, I am interested in the relation of the field tests to the scientific work that is done in the laboratories by you men in the scientific field. I recall my short acquaintanceship with a great character by the name of Dr. Kettering. Dr. Kettering one time told me that in his work on the diesel motors—and he has had considerable to do with that, I am told—was told that a number of scientists and technical men in checking the ratios said, "It is impossible," and said, "That won't work." They were scientific-minded men, and honest in their views.

So as I understood, they came over and checked the situation and rode behind a diesel. And Dr. Kettering reminded them, "Well, you are riding behind one. How does it work?"

One of them said, "Well, I'll be so and so," and down the line, but he saw that the field tests demonstrated something that did not get off the drafting boards and the calculations.

Now, I will say one other thing. I have also heard from some of these same sources that the automotive companies have great testing grounds where the engineers, the fine scientific men on the ratios and all the tolerances, have said that this is the way it will work. And they take it out on those field tests and the field tests determine that from the practical operational standpoint, it has got bugs in it, and does not work. Then they bring it in and they work it over and say, "By all odds, we have discovered something here. It does work." Then by all odds it comes out in a new product, and it does work.

I am mentioning that for this reason. Here is the difference between a practical operation of something and what you find from the scientific approach to it. Now, maybe someplace in here somebody has slipped in the calculation or the actual practical results available.

To the lay mind, that means something over here, with the repeat orders by the hundreds and maybe by the thousands, if they could get their records together. To the scientific determinations that you gentlemen have made, you say no, that other factors may enter in there, and in all probability that may be the case. But we have this troublesome question up here now for determination one way or the other.

Starting with that statement, I want to point out that phase of the thing. We are up against the practical approach to this thing, the practical results of it, the practical results that will happen to a business when people are connected with it who are covered by an order that they cannot go forward on. Right or wrong, I hope that will be resolved.

In your statement, I think you said that the Bureau was looking for laboratory effects first. After the issuance of the MIT report, you said, however, that you were trying to relate tests to actual field tests. Why did you do that?

Dr. ASTIN. No; I did not——

Senator SCHOEPPEL. Or am I quoting you correctly?

Dr. ASTIN. No. I think you misunderstood me slightly, Senator. I was saying that we were trying to relate the MIT effect to conditions of normal use. Now, the first thing one would do in normal use is to put in an electrolyte of normal density, and as soon as that is done the effect they report disappears.

Senator SCHOEPPEL. I think you have answered before, but how many cells did the Bureau test with AD–X2 before you made your report to the FTC? How many actual tests did you make on cells?

Dr. ASTIN. On the FTC, there were 6 batteries of 3 cells each. That is 18 cells. That was the FTC's own test.

Senator SCHOEPPEL. How many were treated before your report on 504?

Dr. ASTIN. There were only 2 batteries, or 4 cells, with AD–X2 in 504, but there were a lot of other mixtures of sodium and magnesium sulfate in there, too. And so the AD–X2 data which was included in 504 without the name was just one of a series of mixtures of sodium and magnesium sulfate, so that one has to consider, in interpreting the data, all of the other tests on sodium and magnesium sulfate. And when the other samples are considered, it was an adequate sample for the conclusions which were drawn.

Senator SCHOEPPEL. I have been concerned about the effects of AD–X2 as found by MIT. I thought that, from the way I read it, they were significant. Why was it only after the MIT report was made that people in your department make any mention of any of these effects if they were troublesome or otherwise? Now, I would like to have that point cleared up, for my own satisfaction.

Dr. ASTIN. Our tests on the material before have been carried out in the range of acid densities which are encountered in the normal charge and discharge cycle of a battery. The effect reported by MIT was obtained with acid densities below that range. That is why we had not encountered that. It is an effect which is beyond the range of normal battery operation.

Senator SCHOEPPEL. Now, in the checking of the record——

Dr. ASTIN. One of the things is that it had water put in it for the electrolyte. Nobody runs a battery with only water in it. Sometimes water is used in an effort to reduce the sulfation, but then, after that is done, acid is added. And that is why I think we never encountered the effect reported by MIT, as it occurs at a density which we considered beyond the range of interest.

Senator SCHOEPPEL. Is the battery different completely in performing its function when solutions are diluted?

Dr. ASTIN. The solution gets dilute as the battery discharges.

Senator SCHOEPPEL. It retards its effectiveness? Or does it?

Dr. ASTIN. As the acid concentration becomes lower it is able to supply less energy, other things being equal.

Senator SCHOEPPEL. Now, the Marine Corps tests seem to indicate that when the storage batteries are treated it is easier to charge batteries that are treated with AD–X2. Is that possible, or is that an erroneous assumption? Or what have you got to say about that?

Dr. ASTIN. We have never been able to find any beneficial effect of AD–X2 or any other mixture of sodium and magnesium sulfate in the charging process of a battery. I can make that statement categorically. We have found no beneficial effects of these mixtures on the charging process of a battery.

Senator SCHOEPPEL. Now, as against that, we have commercial users who inform us that they have tried and discarded many other additives and now use and support AD–X2. Now, is that just a psychological reaction, or are they sympathetically inclined, or what? Now, that is the practical side of it again.

Dr. ASTIN. Senator, I really cannot answer that question. I can postulate as to what it might be. But I most certainly do not know the answer. I am confident that it is not due to any physical benefit which occurs within the battery itself due to the additive.

Senator SCHOEPPEL. There was some discussion here and testimony to the effect—I heard Mr. Ritchie this morning, and I am sure he feels pretty strongly about it—that the Bureau in its tests did not follow fully the directions that he and his associates had set forth. Now, if that is the case, why was it not done? Or are we befogged on that issue?

Dr. ASTIN. To explain it clearly, I would prefer that this is a question you let the National Academy Committee settle. However, I will try to clarify it.

A number of the changes which were made were trivial. The only one I really heard him criticize severely is this one about the acid density. He had initially requested that when the acid density in the batteries reached 1.280 we then withdraw acid and add water. We refused to do that for this reason: We know that the introduction of magnesium and sodium sulfate mixtures into the electrolyte of a battery raises the specific gravity by a definite, measurable amount. You put more stuff in solution, and its density goes up. Therefore, it would have been highly probable, because of this constant difference, that the treated batteries would have reached the 1.280 reading before the untreated batteries, and then we would have been possibly pulling acid out of the treated batteries and adding water to them, and not doing this to some of the untreated batteries. This would have meant, then, that the exposure conditions between the treated and the con-

trols would have been different. This would have violated one of the fundamental criteria for running a proper controlled experiment. That is, we would have given a different environmental condition or handling procedure to the treated batteries than we would to the controls. So then the results would have been jeopardized.

This went back and forth. I told him one time in a letter that we would not pull acid and add water. We finally, in a discussion, tried to convince Mr. Ritchie that this would make no difference, and got his concurrence just a day or two before we started the tests, that we would raise the limit to 1.325 instead of 1.280, and then if a certain percentage of the cells in any charging line reached this density, we would pull acid in all of them and add water. This, then, would have insured equal treatment to all of the samples, which was an essential thing for the validity of the experiment.

Senator SCHOEPPEL. I note that reference has been made here to some of these changes that take place, that they would be trivial. Now, do you folks in your department say that?

Dr. ASTIN. I say that the changes were trivial; yes, sir.

Senator SCHOEPPEL. You probably have answered this, but I am concerned about it. If the specific instructions given by Mr. Ritchie and his associates to be followed were not followed, I could see where he would have some logical reason to say, "Well, they are not cooperating fully on this thing," because there are successful users. Apparently this committee and I have searched, and I have made inquiry, but I have not received one single instance of customer kickbacks or objections.

Now, you can fool a lot of people if they have a dead duck on somebody's table. This new committee will probably give that a conclusive test, then, specifically following these instructions, or someone will, will they not?

Dr. ASTIN. I——

Senator SCHOEPPEL. Of course, you should not speak for them.

Dr. ASTIN. I could not speak for the committee. They are qualified to supply the answer. I will stand on the fact that they are qualified to give the answer.

Senator SCHOEPPEL. In your statement of February 10 of this year to the House Interstate Commerce Committee, it was reported that you people noticed many differences in treated cells. Well, if that was the case, aren't these changes or these differences, then, significant, and should they not have been followed up? Or do we have an explanation for that?

Dr. ASTIN. I am not quite sure that I understand which changes you are referring to, sir.

Senator SCHOEPPEL. I just noticed your statement. You said in your statement of February 10, 1953, to the House committee that you noticed many differences in treated cells, and the question comes up, "Then aren't these differences significant?"

Dr. ASTIN. What page is this on, Mr. Senator?

Senator SCHOEPPEL. It referred to the temperature changes and the size of, for the lay standpoint, I will say the bubbles, the operational effect of the battery.

Dr. ASTIN. There is a difference in the bubbles that are formed by the addition of this salt. That is definite. But as far as we know, big bubbles or little bubbles make no difference.

Senator SCHOEPPEL. Could we get into this record at this point, because that seems to be one controversy that is raised: Why is it different?

Dr. ASTIN. We have not yet been able to find out why the appearance of the bubbles with sodium and magnesium sulfate in the solution is different from what it is without it. We have several theories, but we are convinced that these bubbles have no significant relationship to battery performance. There is no controversy over the existence of the bubble effects. That is, we admit that there is a bubble effect.

The CHAIRMAN. Dr. Astin, let me ask you about the flaky parts that might drop off the cell bodies themselves. If the compound additive would have a tendency to break that up, would that not add to the life of the battery by preventing shorting by the particles of lead that might be of such size that they could join and thereby create a short in the battery?

Dr. ASTIN. As active material drops off the plates and settles on the bottom, if it built up high enough, it can cause a short; yes, sir.

The CHAIRMAN. Yes. This treatment will prevent this condition.

Dr. ASTIN. It does not. It has no measurable effect on the amount of sedimentation formed.

The CHAIRMAN. Now, you have only carried on an experiment for 2 weeks.

Dr. ASTIN. Oh, we have carried——

The CHAIRMAN. That is a disturbing factor in my mind. A field test would give you quite a period that you could examine this, whereas a 2-week test does not give you the length of time to examine it.

Dr. ASTIN. We have run experiments over many months on treated batteries and untreated batteries. The test that was completed within 2 weeks was the one run last June, the one which Mr. Ritchie specified for us. As a mater of fact, the batteries which were run last June, which were tested last June, have subsequently been tested additional times. Here now we have a group of batteries that have had the treatment in them for a year, and they have been used for various things, and there is still no difference between the treated and untreated batteries.

Now, this is the group that we have based our experience on.

The CHAIRMAN. You have used them in a perfectly normal operative manner?

Dr. ASTIN. These actually were stored, and one of the claims—well, it is known that batteries frequently will deteriorate more rapidly in storage than when in use.

The CHAIRMAN. Any time they have lost a charge.

Dr. ASTIN. These were then stored. I think they have been taken out and used twice since the tests last June, and in those instances where we pulled these batteries out and tested them again, there is still no difference between the treated and the untreated batteries. So to some extent, this particular experience could be construed as a field test.

The CHAIRMAN. Yes, but you only use them periodically. They were only charged occasionally.

Dr. ASTIN. Only these were stored on a shelf rather than in an automobile.

The CHAIRMAN. I have seen a battery eat itself up standing right in a basement over the winter months because the charge was down in the battery, and the battery was acid-eaten and destroyed standing still for 6 months. And a battery can do that on a shelf or in the basement of a home.

Dr. ASTIN. That is right.

The CHAIRMAN. Surely.

Dr. ASTIN. But it is my understanding that one of the claims that has been made for these materials is that they improve the storage characteristics of a battery, because it is known how badly they can deteriorate in storage, and our experience is that it has no effect on the storage characteristics or any other performance characteristics.

The CHAIRMAN. Senator Schoeppel, I interrupted you.

Senator SCHOEPPEL. That is all right, Mr. Chairman. I have a number of other questions, and I want to defer to these other gentlemen.

Senator GILLETTE. Mr. Chairman.

The CHAIRMAN. Senator Gillette has been sitting patiently here all afternoon, and I would like to accommodate Senator Gillette.

Senator GILLETTE. May I ask how long the chairman expects to continue?

The CHAIRMAN. I was hoping that we could finish around 5 o'clock. That has made a pretty good day. But if you can finish, we may remain a few minutes beyond 5. Then we will resume at 10 o'clock tomorrow if we are not through.

Senator GILLETTE. Mr. Chairman, I could finish, but Senator Smathers is waiting here.

Senator SMATHERS. I have been sitting here not so patiently.

Senator SPARKMAN. And Senator Saltonstall.

Senator GILLETTE. Senator Saltonstall. But I will proceed if the chairman wishes.

The CHAIRMAN. We will resume tomorrow morning at 10 o'clock. But you may proceed now.

Senator GILLETTE. Right.

Dr. Astin, I would like to repeat what some of my colleagues have said here, that I have the highest respect for the Bureau of Standards, and I have great admiration for you personally. But I am disturbed over the situation that is presented to us here. This record here shows as nearly as I can compute it, over $400,000 worth of business over a period of 5½ years done by this concern. The testimony of Mr. Ritchie was that these packets sell at retail for $3. If it was based on retail sale, there would be 135,000 purchasers. If you allow 35 percent for the distributor, on a $2 basis, there are over 100,000 customers.

Have you had or do you know of any instance of the 100,000 customers or any one of them complaining that they were defrauded or sold a worthless article when they purchased this material?

Dr. ASTIN. Yes, I have; but I have taken no effort to follow up these things. After all, that is out of our field, to attempt to develop or check or verify claims that the people have not gotten their money's worth.

Just yesterday morning I got a telegram from some place in Massachusetts, of a man telling me he had tried this product and found it worthless. And I have heard indirectly of some others. I am quite sure that if one made a serious effort to develop a list of dissatisfied users, it could probably be done. But, honestly, I have made no effort to do it, because I do not think that it is any business of mine.

Senator GILLETTE. It is not the business of the Bureau of Standards, is it?

Dr. ASTIN. To determine——

Senator GILLETTE. At the time the Bureau of Standards took this work, these tests——

Dr. ASTIN. This would amount to a market survey, sir, and that is out of our category.

Senator GILLETTE. Certainly. At the time you undertook these tests on the AD–X2, had you received any complaints asking you to make a test on the part of purchasers of this material?

Dr. ASTIN. To the best of my knowledge, we had not, sir. That is, the first test that was made on this material came about largely because of the instigations from Mr. Ritchie through the Oakland Better Business Bureau, and to Senator Knowland.

Senator GILLETTE. Now, in response to a question from the chairman, you made the comparison of a person afflicted with some disease. If I had a certain disease, and you were a doctor, and a doctor prescribed a medicine and I took it and recovered, you as another doctor could very well say, "Why, he would have recovered, anyway. That was worthless stuff that he took. It didn't do him any good. And he would have recovered anyway." You could have done that, could you not?

Dr. ASTIN. A person can say that. He would not have any basis for establishing the truth or error of it.

Senator GILLETTE. Now, if this doctor used that for 100,000 patients and they all recovered, or you had no evidence that it failed, would you not be inclined to think that there was some value in the treatment?

Dr. ASTIN. I would be inclined—yes, under that circumstance, I would be inclined to give some value to it, provided it was known that recovery was longer or impossible without the cure.

Senator GILLETTE. Then, bringing it down to the instant case here, if you had no complaint in the Bureau of Standards from over 100,000 purchasers of this article, would you not be persuaded, outside of your scientific knowledge that it was worthy of some consideration?

Dr. ASTIN. Oh, yes. I can understand completely the interest of your committee in this problem, because the large evidence of satisfied users is, to say the least, very convincing.

Senator GILLETTE. And very persuasive?

Dr. ASTIN. Very persuasive.

Senator GILLETTE. Now, personally—I am speaking not for the rest of the members of the committee, but for myself—I do not know the first thing about whether this material is of value or not. What I am interested in, and I am sure the other members are in agreement with me on this, is whether or not there was in this entire investigation any discriminatory action against a company or a manufacturer anywhere along the line. Now, you have stated that there was nothing in the

genesis for your action here, your investigation of this particular additive, that came to you by way of complaint from consumers?

Dr. ASTIN. That is correct.

Senator GILLETTE. That is so. You have also stated that 28 Senators and 1 Congressman—that is about a fair sample of relative value—brought to the attention of the Bureau of Standards complaints that had come to them relative to this additive.

Dr. ASTIN. Yes, sir.

Senator GILLETTE. Were those complaints or any of them based on complaints of consumer constituents?

Dr. ASTIN. No. These were complaints by the distributors of the Battery AD–X2 that the National Bureau of Standards was not giving him a fair deal. That was essentially what they were.

Senator GILLETTE. Now, in response to a question from the eminent Senator from Alabama, I believe you stated that somebody representing a better business bureau had written you, or written to someone in your organization, stating that there were complaints on the part of battery manufacturers that the sale of this product was interfering with their business. Did you testify to that? Did I understand that?

Dr. ASTIN. I do not recall exactly all of the correspondence from the National Better Business Bureau. Their contention to us was that Pioneers, Inc., was arguing that their product should be exempted from the prior statements they had been making about battery additives——

Senator GILLETTE. Yes.

Dr. ASTIN (continuing). And stating also that the National Bureau of Standards had not tested the material. Well, in view of the fact that we had tested it and found it to be no different from the other battery additives, it was felt by the people who made the decision that it was proper to allow the National Better Business Bureau to use this information.

Now, I am not familiar with all of the motivations behind the National Better Business Bureau's request to us. There may have been—there must have been—some communications with the battery manufacturers.

Senator GILLETTE. But I believe, if I understood correctly, that in the letter from which Senator Sparkman read, which was a letter from your Mr. Vinal, in response to a statement or a complaint that was made by the Better Business Bureau on behalf of manufacturers, it was suggested by your Mr. Vinal that it was not your policy to take up complaints of that kind and make tests on those complaints, but that if it came to you from the Federal Trade Commission, you would feel justified in undertaking such an investigation; is that true?

Dr. ASTIN. We would not only feel justified; we would feel compelled to.

Senator GILLETTE. And in your opinion, you do not think that was a suggestion on the part of your organization to the complainants that they come to you through the Federal Trade Commission?

Dr. ASTIN. I do not think it is possible for me to interpret what was in Dr. Vinal's mind at that time. I knew Dr. Vinal before he retired, and I know that he did not like testing these battery additives. I am sure that he would not have deliberately sought to have somebody ask that another test be made.

Senator GILLETTE. I am being unfair to you in asking you to evaluate the statement made by Dr. Vinal.

Dr. ASTIN. I do know that Dr. Vinal was trying to be helpful to the National Better Business Bureau in explaining our situation to them with respect to the way the Bureau would undertake a test of this sort.

Senator GILLETTE. Now, may I read, Dr. Astin, the letter to which I referred, of June 22, 1949, addressed to Mr. K. B. Willson, National Better Business Bureau, Chrysler Building, New York, and signed by George W. Vinal, Chief of the Electro-Chemical Section, Division of Electricity and Optics:

> Reference is made to your letter of June 17 regarding AD–X2. It has been our policy not to make any tests on commercial products until requested to do so by some Government agency which is interested in the merits of the product. If this matter is turned over to the FTC, it is possible we may be requested to make tests.

Now, if that is not a suggestion as to how to proceed to ask your organization to make tests, I do not know the English language, Doctor.

Dr. ASTIN. It can be interpreted as a suggestion, yes. It is also a factual statement.

Senator GILLETTE. It was interpreted so; was it not?

Dr. ASTIN. It is my recollection as those dates were read to me that this letter is some 9 months before the test actually came to us, for additives.

Senator GILLETTE. Now, I want to refer to your technical report——

The CHAIRMAN. Senator Gillette, will you yield for just a moment at this point?

Senator GILLETTE. Of course.

The CHAIRMAN. When did Dr. Vinal leave the Bureau of Standards?

Dr. ASTIN. Dr. Vinal retired from the National Bureau of Standards in June of 1950, after 43 years of service.

The CHAIRMAN. And where is he now?

Dr. ASTIN. He is now living in Princeton, N. J.

The CHAIRMAN. Is he connected with any firm?

Dr. ASTIN. I think he is doing some consulting work for two organizations: One, the Radio Corp. of America; and the other is the Electric Storage Battery Co.

The CHAIRMAN. Then he is doing consulting work for Electric Storage Battery?

Dr. ASTIN. Yes. As long as we have raised Dr. Vinal's name, I would like to state that Dr. Vinal is considered one of the outstanding authorities in this country on batteries. He is the author of two major textbooks on batteries, and the author of many original scientific papers. He was given in the 1930's, I think around 1938, for the first time to a scientist, the Gastone Planté Medal by the French Electrical Society, and he is a really outstanding individual in his achievements.

The CHAIRMAN. Dr. Randall, too, was recognized as an outstanding scientists in that field; was he not?

Dr. ASTIN. I do not think that Dr. Randall in this particular area was in Dr. Vinal's class.

The CHAIRMAN. He was not in his class?

Dr. ASTIN. That is right.

The CHAIRMAN. But he was an eminent scientist in that field, though, was he not?

Dr. ASTIN. He was very well known.

The CHAIRMAN. Yes; and known as a man who understood the field of electronics and storage batteries, was he not? I am just trying to get the facts.

Dr. ASTIN. I would not endorse him.

The CHAIRMAN. You would not? I am sorry, Senator Gillette. You may proceed.

Senator GILLETTE. That is perfectly all right, Mr. Chairman.

Doctor, I am referring to Technical Report 1537, issued by your Bureau dated April 1951, and I quote from it:

> During the last 30 years, more than 100 different battery additives, both powders and solutions, have appeared on the market. Most of the solutions have consisted of sulfuric acid, sometimes with additions of sodium sulfate, magnesium sulfate, or coloring matter.

This goes on to state that, based on the 30 years of studies and investigations of over 100 different additives, they had reached certain conclusions. And, subsequent to the issuance of your 504, the United States Department of Commerce, under the letterhead of Charles Sawyer, Secretary, and the National Bureau of Standards, E. U. Condon, Director, issued a press release in which they state:

> Results of extensive study of popular "battery restorers," claimed to rejuvenate wornout automotive storage batteries, have just been released by the National Bureau of Standards. Many of these preparations are being sold daily with the promise that in a new, failing, or dead battery, the useful life of the battery can be greatly increased. The Bureau has tested most of these additives for the Federal Government and found them of no value. In fact, there seems to be no difference between the life of "doped" batteries and untreated batteries used as control.

Similarly, discussing the question of the use of additives, in the light of experience and investigations that have been made, "The results of the Bureau's studies have been published in Circular 504,"—so this is subsequent to that—" 'Battery Additives,' which may be obtained from the Superintendent of Documents, United States Government Printing Office, Washington, D. C., for 15 cents per copy."

Now, if after your organization had waited from 1931 to 1949, 18 years, without making any special investigation, then in the light of complaints that had come from the Better Business Bureau through the FTC, you had undertaken an investigation of this particular additive, why do you consider that it was incumbent upon the Bureau of Standards, through the Department of Commerce, to circularize the United States on the question of additives based on its experience of 30 years. Why did the Bureau suddenly have this rejuvenation of interest in additives?

Dr. ASTIN. There were a number of contributing factors on that. First, there were a number of new additives that appeared on the market following the end of World War II; and, second, we had tested a number of these for the Federal Trade Commission, Post Office, or the Navy Department. The Navy had been interested in the development of means of improving the technique for storing batteries. We had accumulated this information. We had a much broader experience in 1950 than we had in 1931. There was a lot of

information we had. To withhold it from the public would make us subject to criticism, too.

That is, here is technical information, which means that these types of dopes are not helpful to storage-battery operation. If we withheld the publication of such information, that also is a position which could be criticized.

Senator GILLETTE. But you felt no incentive over the past 19 years to circularize or disseminate this information?

Dr. ASTIN. No. There are other types of circulars which the National Bureau of Standards puts out in other categories. This just happened to mature at that time. Now, if you recall, our basic legislation on publications authorizes the Bureau to publish the results of its scientific findings when such things are of importance to scientific or manufacturing interests.

Now, the National Better Business Bureau says that this data was of importance to the commercial interests of the country, and that became a factor in the decision to publish that circular, and it was, I think, following the standards prescribed in our legislation.

The CHAIRMAN. Senator Gillette, would you yield just for one moment?

Senator GILLETTE. Yes.

The CHAIRMAN. I find a letter here in the file of copies of letters that had been exchanged between the Bureau of Standards and the Better Business Bureau, and here is a copy, dated March 7, 1950, addressed to Mr. K. B. Willson, National Better Business Bureau, Inc., Chrysler Building, New York. It is signed by George W. Vinal, Chief, and he, of course, is the Dr. Vinal to whom we have been referring in the Bureau of Standards. This is the letter:

> In response to your telegram of March 3, which I did not receive until March 6, and my reply of the latter date, I am sending herewith rough draft of the proposed circular on battery additives. I had hoped to have it in somewhat better shape before sending it to you. I shall be glad to have your comments and criticisms of both the scientific information and its legal aspects as you have learned from past experience.

Was it proper for the Bureau to have lent its aid in the preparation of literature and circulars, and so forth, with which the Better Business Bureau was going to circularize the countryside?

Dr. ASTIN. I would like to repeat again, our legislation authorizes us to disseminate the information we accumulate when such data is of importance to scientific or manufacturing interests. We had information which had apparent importance to the public. The National Better Business Bureau said it was important.

Now, since our legislation specifically states that we should appraise the interest of science and manufacturing interests before we publish data, I see nothing wrong with that. We were not lending ourselves, in my opinion, to a campaign. We were performing what to these groups was a useful service, and we did not get the data because they asked us to; we had the data in connection with the fulfillment of our functions for the other Federal agencies. This data in general form was available. The people who represent the business community of this country, I believe—and the National Better Business Bureau is in that category—claimed the dissemination of this information would serve a useful purpose. Now, I would consider that a legitimate procedure. If, however, this committee does not think it so, then we would like your guidance on that.

The CHAIRMAN. You know, Doctor, we are just searching for information. We want to be certain that the small-business man who thinks he has something, and a great number of others think he does, too, is not stifled.

Dr. ASTIN. Doesn't the National Better Business Bureau represent small businesses?

The CHAIRMAN. They do. That is absolutely true. But here was a small-business man who was endeavoring to establish himself, and apparently there were a lot of satisfied customers. But there was another agency that represented themselves as the National Better Business Bureau, Inc., and they were taking it upon themselves to circularize the entire countryside by a positive statement relating to a report which the Bureau of Standards had submitted and, of course, that would mean "curtains" for that businessman.

Senator GILLETTE. And, Mr. Chairman, on complaint of other manufacturers who claimed that they were being hurt. That complaint was made to the Better Business Bureau.

The CHAIRMAN. You may proceed, sir. I beg your pardon for interrupting.

Senator GILLETTE. I will just ask two questions in closing. I will not take any more of the Doctor's time.

Doctor, you have just quoted the law which permits you to publish these reports, and that, of course, is undoubtedly true. But under what circumstances are reports prejudicial to certain manufacturers published by your organization?

Dr. ASTIN. We try to confine our reports merely to the presentation of technical data, and we hope thereby that since it is straightforward data, nobody can complain that they are being discriminated against. That is, I gave in my general statement the example of tests on aluminum. It might show that tests on aluminum under a particular set of conditions favor superior performance characteristics to steel. Now, would we withhold the dissemination of that data because the steel people would not like it? It is a cold, hard scientific fact. You disseminate it. To withhold the dissemination of scientific information I think is the most prejudicial action.

Senator GILLETTE. Why was not that report to the FTC made confidentially to them?

Dr. ASTIN. The report to the FTC was confidential to the FTC.

Senator GILLETTE. Now, my last question is this. I made a notation here as you were testifying in your general statement, and I may have it in error. If so, I want to be corrected. I made this notation:

The request by the Better Business Bureau that the AD–X2 be named in the report.

Was that true?

Dr. ASTIN. Yes, sir. The National Better Business Bureau made two requests. One is that we permit the NBBB to answer some of the complaints made to them by either the Oakland Better Business Bureau or Pioneers, Inc.—I am not sure which—explaining that the National Bureau of Standards in fact tested AD–X2 and found it no different from anything else. That authorization was given.

Senator GILLETTE. Then, on the request of the Better Business Bureau, based on the report that they had made to you, you deviated from your policy and named a manufacturer here of an article that was in question?

Dr. ASTIN. This was a deviation not in a report submitted by the Bureau, but in a report which the National Better Business Bureau was allowed to circulate. And it was a deviation, and the deviation was simply justified at the time on the grounds that it was necessary to correct erroneous statements which were being made, both about the circular of the National Better Business Bureau and about tests which the National Bureau of Standards had conducted.

Senator SCHOEPPEL. Mr. Chairman, would the Senator yield for one question at that point?

Senator GILLETTE. I am through, just with this word. I am glad you made the statement that it was presumably the thing to do at that time.

Dr. ASTIN. I said earlier, when one of the other Senators asked me the question, that this is a decision that could have been made either way, and I think either way can be defended; either way can be criticized.

Senator GILLETTE. I shall be glad, Mr. Chairman, to yield to the Senator from Kansas.

The CHAIRMAN. I am apologetic to Senator Smathers.

How long will it take, Senator Schoeppel?

Senator SCHOEPPEL. One question. I want to get one thing in the record.

Senator SMATHERS. Mr. Chairman, may I say this? I am perfectly agreeable to sitting here and having my distinguished colleague from Kansas, who is usually and always very thoughtful about those of us who sit on this end of the totem pole, proceed. But I would just like to ask the indulgence of this committee that tomorrow when we start, would it be possible for me to start off with the questioning at that time?

The CHAIRMAN. I have endeavored to alternate from left to right.

Senator SMATHERS. I think that is fair.

The CHAIRMAN. You, sir, will be the first gentleman recognized tomorrow morning. I will assure you that.

Senator SMATHERS. Thank you, sir.

The CHAIRMAN. Dr. Astin will be with us tomorrow morning, will you not, sir?

Dr. ASTIN. Yes, sir; if you wish.

The CHAIRMAN. All right.

Senator SCHOEPPEL. I wanted to get this into the record at this point, or right in this series of questions and answers, Dr. Astin, for one particular reason, because, if my memory serves me correctly, it was in April of this year that Mr. Brode, of your Department, testifying before the Senate Committee on Appropriations—and I am sure he was under oath—said this, and this concerns the Better Business Bureau. It might clear up some points as to what your Department thought of the relationship of the Better Business Bureau. Senator Ellender was questioning him, and Senator Ellender asked him this question:

You never did give the results to any of the Senators who wrote to you, but you did make your findings available to whom?

In the form of a question. This was Mr. Brode's answer:

Mr. BRODE. The Federal Trade Commission and the Post Office Department, and as a result of the pressure we have reported to one—

get this—

quasi-Federal agency or public agency, the Better Business Bureau.

Well, now, that is the first information I have had that that Better Business Bureau is a quasi-Federal agency. Is that the way they are construed?

Dr. ASTIN. I think that may have been a misunderstanding. I have not heard it construed that way, unless it has a Federal charter. If it has a Federal charter, it might be so construed. But I am not sure about that.

Senator SCHOEPPEL. I was wondering if that was the reason why the correspondence or the inquiries directed from that Bureau through whatever channels it was into your Department made this seemingly—as you have been questioned here—maybe a little irregular approach. But this is from the testimony which was given under oath before the Senate Appropriations Committee.

Dr. ASTIN. Our affiliations with these national groups are of two kinds: one for the exchange of technical information; and one is to get ideas as to what things are of importance. We are supposed to serve science and industry, and it is only through working closely with groups representing science and industry that we are able to appraise the needs.

Now, the National Better Business Bureau is one of the organizations that we hold in high esteem.

Senator SCHOEPPEL. That is right.

Dr. ASTIN. And we have worked with them throughout the years.

The CHAIRMAN. Senator Smathers, we have had a quorum call. We are trying to ascertain what the call is for. So in the meantime, we will proceed, and you may proceed.

Senator SMATHERS. Mr. Chairman, if I had any "rathers" on this, I would "just as soon rather" start tomorrow morning, if that would be all right with you, sir. It is 10 minutes after 5, and there is a quorum call.

The CHAIRMAN. We will recess until 10 o'clock tomorrow morning.

Thank you, Doctor. We are sorry that we have kept you all afternoon. But you are going to be here tomorrow morning.

(Whereupon, at 5:10 p. m., the committee recessed, to reconvene at 10 a. m., Wednesday, June 24, 1953.)

BATTERY AD-X2

WEDNESDAY, JUNE 24, 1953

UNITED STATES SENATE,
SELECT COMMITTEE ON SMALL BUSINESS,
Washington, D. C.

The committee met, pursuant to adjournment, at 10:05 a. m., in the caucus room, Senate Office Building, Senator Edward J. Thye (chairman) presiding.

Present: Senators Thye (chairman), Ferguson, Hendrickson, Schoeppel, Duff, Sparkman, Hunt, and Smathers.

Also present: Robert A. Forsythe, chief counsel; Blake O'Connor, professional staff member; and William D. Amis, investigator.

The CHAIRMAN. If the committee will please come to order, we will resume the hearing. Dr. Astin, will you take your chair up here? We will proceed where we left off last evening.

Good morning, sir.

Dr. ASTIN. Good morning.

TESTIMONY OF DR. ALLEN V. ASTIN, DIRECTOR, NATIONAL BUREAU OF STANDARDS—Resumed

The CHAIRMAN. It was agreed last evening that Senator Smathers would proceed with the questioning when we reconvened this morning.

Senator Smathers?

Senator SMATHERS. Thank you, Mr. Chairman.

Doctor, I wonder if you will take just a moment and tell us where you got your education.

Dr. ASTIN. I received my bachelor's degree from the University of Utah and my master's and doctor's degrees from New York University, and then I served under a National Research Council fellowship for 2 years at the Johns Hopkins University.

Senator SMATHERS. Have you ever been the recipient of an honorary degree?

Dr. ASTIN. That is sort of an embarrassing question in a way, because just last week I was given an honorary doctor of science degree by Lehigh University, Bethlehem, Pa.

Senator SMATHERS. When did you first go to work for the Bureau of Standards?

Dr. ASTIN. I went there first in 1930 as a research associate employed by the Utilities Research Commission of Illinois, and in 1932 I joined the staff as a civil servant.

Senator SMATHERS. In 1930, was there any politics mixed up with the fact that you went to work for the Bureau of Standards?

Dr. ASTIN. I do not think so.

Senator SMATHERS. Did you ever study any salesmanship when you were in college?

Dr. ASTIN. No, sir.

Senator SMATHERS. As I understand it, then, you are a scientist, purely and simply?

Dr. ASTIN. I don't pretend to be anything else.

Senator SMATHERS. The thoughts of salesmanship or persuasion or psychology are outside the realm of your field?

Dr. ASTIN. I have not studied those areas.

Senator SMATHERS. Doctor, when did the question of battery additives first come to your attention?

Dr. ASTIN. It was during the summer of 1951, to the best of my recollection. Dr. Condon, who was then Director of the Bureau, was away from Washington rather extensively that summer, and I was Acting Director in his absence, and I became aware of the problem at that time. I mentioned yesterday, you may recall, a letterwriting campaign to the Congress that started in the summer of 1951, and I got into it at that time.

Senator SMATHERS. That was the first time that you as an individual got into this question of battery additives?

Dr. ASTIN. I would not say it is the first time I heard of it. It is the first time I had any responsibility for it.

Senator SMATHERS. Do you recall from your study of this problem how many times the Bureau of Standards has made a test on battery additives, or approximately how many?

Dr. ASTIN. It is on the order of 50. I have a list here going back to the early 1920's. It is something of the order of 40 to 50 that have actually been tested in the Bureau's laboratories over the past 30 years.

Senator SMATHERS. I have a list in front of me from the Federal Trade Commission which shows that since 1919, they have run about 48 tests on battery additives, and that apparently all of them were with the same result.

Do you recall when the Bureau of Standards first ran a test on AD–X2?

Dr. ASTIN. Yes. That started in January of 1949.

Senator SMATHERS. And what was the occasion for that? Do you recall who requested that that test be run?

Dr. ASTIN. The test was actually run on the Bureau's own initiative, but there had been prior requests from Senator Knowland and from the Oakland Better Business Bureau. About that time, the Federal Trade Commission had asked the National Bureau of Standards to run an evaluation on another battery additive, and it was felt that with very little added effort, AD–X2 could be put in and run along with the other additive, and that was the occasion for starting the test.

Senator SMATHERS. Now, at the time that this first test was run by the Bureau of Standards, did you know Mr. Ritchie, or had you ever heard of Mr. Ritchie?

Dr. ASTIN. The first I had heard of Mr. Ritchie was in the summer of 1951.

Senator SMATHERS. So, at the time the first test was run in 1949 and the results presumably sent to the Federal Trade Commission, you had never heard of Mr. Ritchie?

Dr. ASTIN. No, I had not. I didn't know anything about that particular testing procedure.

Senator SMATHERS. Do you know whether the result of the test in 1950 was positive or affirmative? Was it favorable or unfavorable?

Dr. ASTIN. The test initiated in January of 1949 yielded a negative result, in that no beneficial effects were found.

Senator SMATHERS. Do you recall when the second test was run, what year that was? Was that in September of 1951?

Dr. ASTIN. There was a request from the Post Office Department in September of 1951, but the Post Office Department was given, in response to that request, the data obtained from the test beginning January 1949, and the second test for the Post Office Department started about the first of 1952, and there was almost simultaneously a second test about that time for the Federal Trade Commission. So the second and third tests which were run by the Bureau on AD–X2 were in the winter of 1951–52. I do not recall the exact dates.

Senator SMATHERS. Now, at any of those tests which were run by the Bureau of Standards on AD–X2, was Mr. Ritchie present or were any of his representatives present?

Dr. ASTIN. Not during these three tests that we have discussed so far.

Senator SMATHERS. Was there a fourth test?

Dr. ASTIN. Well, there was a fourth test run in June of 1952. This was the test I mentioned yesterday in which we had asked Mr. Ritchie to describe a procedure which would demonstrate conclusively the merits of his product, and that was the fourth test run on this material.

Senator SMATHERS. And at that fourth test, Mr. Ritchie did indicate to you the way in which he thought the tests should be run?

Dr. ASTIN. That is correct.

Senator SMATHERS. And did you follow those instructions of his?

Dr. ASTIN. We followed them in all pertinent detail. There has been some argument about deviations from his instructions. I explained yesterday generally what those deviations were. We don't see how the changes we made could have possibly affected the results, and as I said yesterday, I think this is a question which will have to be resolved, if there is doubt about it, by this special committee of the National Academy of Sciences.

Senator SMATHERS. As I recollect your testimony yesterday, the deviation was a matter of acid density; is that correct?

Dr. ASTIN. That is the deviation that has been objected to most strenuously; yes.

Senator SMATHERS. Do you know of any scientific theory or any scientist who would agree or who had agreed that the acid density in such a test would be material?

Dr. ASTIN. I have been able to find no rational explanation of why this would have made any difference at all in the results of the test.

Senator SMATHERS. So, as a scientist, in your opinion, this deviation had nothing whatsoever to do with the results of the test?

Dr. ASTIN. That is correct. And I think I should emphasize again that the deviation was made in order to insure that both the treated and untreated batteries received equal treatment. If we had followed the initial request he made on this acid-density matter, we would have

pulled acid out of the treated batteries and added water, and, in general, have not done this to the untreated batteries.

Senator SMATHERS. So that in your opinion there would have been no way to get a fair test?

Dr. ASTIN. Yes. It is absolutely essential on any controlled experiment that the things that are done to both the controls and the samples be exactly the same, and if one deviates from this, then errors are introduced which spoil the validity of the conclusions. Now, here again, if I can take a minute or two, I think it is important to discuss this business of the controlled experiment and the laboratory and the field test, which I know is a question bothering all the members of the committee.

Many people think that the laboratory test is a sort of theoretical test and that the field test is a practical test. Now, I believe that the reverse is actually true, because in the laboratory test it is possible to make with much greater accuracy and control the measurements by which the comparisons between the two groups of samples can be compared. In the field test, additional variables are introduced; it is more difficult to make the measurements by which one will evaluate the performance of the two samples, so that from a strictly practical point of view, you can learn more about the effect of an additive in a laboratory test than you can in a field test.

Senator SMATHERS. Have you ever known as a scientist any result in a field test which could not be proven out in a laboratory test?

Dr. ASTIN. I know of no instance in a field test where something has been demonstrated of this sort which could not be demonstrated in a laboratory test.

Senator SMATHERS. Now, Doctor, is it possible that you as a scientist could take this powder, AD–X2, and determine what its ingredients are?

Dr. ASTIN. Oh, yes. That has been done.

Senator SMATHERS. As a matter of fact, that is what the Bureau of Standards is supposed to do, is it not, in cases like this?

Dr. ASTIN. That is one of the types of things we do daily in large quantities, and I believe our organization is one of the most skilled in the entire Nation, if not the entire world, in analyzing the composition of chemical materials.

Senator SMATHERS. And because you can determine what ingredients are in it, I presume you can also determine what the percentages of ingredients are in a certain formula such as this; is that correct?

Dr. ASTIN. That is correct.

Senator SMATHERS. Then do you understand why this is a matter of such secrecy?

Let me first ask this question. Then the Bureau of Standards knows everything that is in this formula; do they not?

Dr. ASTIN. I would say that we know everything that is in it in concentrations in excess of five parts per million.

Senator SMATHERS. Now, there has been some mention made of trace elements. Can you identify those trace elements?

Dr. ASTIN. Yes, we have.

Senator SMATHERS. And you can identify the major ingredients in this formula; can you not?

Dr. ASTIN. That is correct.

Senator SMATHERS. And you can identify the percentages of the trace elements and the main ingredients; can you not?

Dr. ASTIN. We have done that; yes, sir.

Senator SMATHERS. Do you see any reason, then, why this should be called some great secret?

Dr. ASTIN. I see no reason for that.

Senator SMATHERS. Certainly it is not a great secret to a scientist, I presume.

Doctor, is there any substantial difference between this additive, AD–X2, and the other additives on which tests have been run during the past, we will say, 10 years?

Dr. ASTIN. We can find no significant difference in this additive and the several dozen others which we have tested during the past 30 years, roughly.

Senator SMATHERS. Did I understand you correctly to say yesterday afternoon that in some of these packages, even——

Dr. ASTIN. May I correct that last statement slightly? Some of the additives we have tested have been definitely harmful, and when I make this statement about AD–X2, I would say it is substantially no different from the other additives composed primarily of sodium and magnesium sulfate.

The CHAIRMAN. If I may interrupt at this point, are we led to believe that the additive is harmful to the battery?

Dr. ASTIN. No, we are not claiming the additive is harmful. According to our latest measurements——

The CHAIRMAN. There was a press report to the effect that it could be and was harmful if used in a battery. Now, I want to be certain that I understood your statement on that.

Dr. ASTIN. I would like to attempt to clarify that. Our more recent investigations have shown that the effect of this material is detrimental rather than beneficial, but the amount of detriment or harm that it creates is so very small as to be completely negligible, I believe, for all practical purposes.

Senator SMATHERS. It is a sort of neutral proposition?

Dr. ASTIN. That is correct.

Senator SMATHERS. Did I understand you to say yesterday that, in these packages of AD–X2, sometimes the amount of the ingredients varies as much as 19 percent?

Dr. ASTIN. That is what I said; yes, sir.

Senator SMATHERS. But you still contend, however, that no matter what percentage these ingredients vary, the result is just about the same on the battery?

Dr. ASTIN. That is correct.

Senator SMATHERS. Now, Doctor, we have heard some testimony here and seen some 135,000 bills of sale indicating that certain people thought that this AD–X2 did them a lot of good. How do you account for that?

Dr. ASTIN. There are a number of explanations, and I am not an expert in analyzing what makes people willing to write testimonial letters. However, there are numerous examples where people believe they are getting beneficial results from some product. Hair restorers, I think, are a very common example. It is easy to get people to believe that they get beneficial action from hair restorers, but I know of no instance where it has been found useful.

Senator SMATHERS. I have tried without success.

The CHAIRMAN. If I may interrupt, the Senator says that he has tried it. I would like that beautiful head of hair that he has in comparison with mine.

You are a poor example, sir.

Senator SMATHERS. Doctor, if the Bureau of Standards runs across one that really works, I would appreciate some inside information.

Dr. ASTIN. On the matter of testimonials, Senator, we cannot accept testimonials, or the sort of things that are considered as testimonials, as scientific evidence. In general, the reports are made by nontrained observers, and the people who supply such information usually have no records or data to support, in a scientific manner, the statements or claims they make. For that reason—first, that there are generally no adequate measurements included in a testimonial, no rigorous specifications of the operating conditions under which the measurements were taken, and usually no controls whatever are used—for those reasons we cannot accept testimonials as scientific evidence.

Senator SMATHERS. Do you ordinarily receive—and when I say "you," I mean the Bureau of Standards—do you ordinarily receive letters from average consumers around the country protesting the failure of some particular commodity to live up to its representations?

Dr. ASTIN. Oh, we receive a few, but we have no jurisdiction or function to handle such things. So we do not receive many, and when we do, we attempt to direct the person to whatever group should handle such matters.

Senator SMATHERS. From your experience as the Director of the Bureau of Standards, do you think that most of the average citizens realize that there is such an agency as the Bureau of Standards?

Dr. ASTIN. I am not in a very good position to comment on its reputation with the general public. With the scientific groups that I know best, it is fairly well known.

Senator SMATHERS. From what you say and from what I know—and I do not want to be testifying here—I can say that I think most people when they have a complaint believe that the best place to write is to their Senator or their Congressman, rather than the Bureau of Standards.

Dr. ASTIN. I would think that is true.

Senator SMATHERS. On the instruction sheet that goes with this AD–X2, do the instructions require that each of these batteries be given a charge?

Dr. ASTIN. It is my recollection that the instructions call for charging the battery after adding the material.

Senator SMATHERS. Is it not a fact that almost any old and tired battery, we will say, if you give it a charge, that by itself would certainly increase its power?

Dr. ASTIN. That is correct.

Senator SMATHERS. And its longevity?

Dr. ASTIN. That is correct. But the difficulty is that most people attempt to charge a battery too rapidly and become impatient in the charging process. The way one revives a tired, old battery is to give it a long, slow charge at low-current densities.

Senator SMATHERS. Was it not formerly a common belief that when your automobile battery was low, the way you would recharge it

would be to take it on a long trip and sort of by that method recharge it?

Dr. ASTIN. That has been done; yes.

Senator SMATHERS. So is it not a fact that just by the mere fact that you would give this battery a charge, whether you add any extra magnesium sulfate or sodium sulfate, the charge alone would increase the potency of the battery?

Dr. ASTIN. Yes; it should.

Senator SMATHERS. Now, do you not think that that possibly could lead to the fact that many people could believe that they were getting some good out of the AD–X2 when, as a matter of fact, the benefit was resulting directly from the charge?

Dr. ASTIN. I think that is a very logical explanation of the reason some of the people believe the material to be helpful.

Senator SMATHERS. It could be sort of like the medical officer here in the Senate when they say, "Now, the way we will make you healthy is for you to take a vitamin pill and eat a 3-pound steak." The vitamin pill will work well if you eat the 3-pound steak.

Dr. ASTIN. Well, vitamins are helpful, too.

Senator SMATHERS. Doctor, is it not a fact that most of the batteries which people turn in, in truth and fact, still have some longevity or some power left in them?

Dr. ASTIN. Yes, I think that is very definitely true. I explained yesterday that many people will turn a battery in before the expiration of its guarantee period as an insurance measure, and just for the fun of it, some of our staff members a year ago went to one of the local stores and bought a lot of secondhand batteries that had been turned in as being at the end of their useful life, and did nothing to them, but just put them in their cars—they did not even charge them—and the first failure occurred after 6 months, according to my recollection.

Senator SMATHERS. In other words, they were able to take batteries and use them for about 6 months, whereas other people had turned them in as being useless?

Dr. ASTIN. Yes; and by doing nothing to them. If they had been given a mechanical overhaul and a bench charge, they would have probably lasted even longer.

Senator SMATHERS. Now, Doctor, the main ingredient of AD–X2, as I gather it from your testimony, is magnesium sulfate and sodium sulfate; is that correct?

Dr. ASTIN. That is correct.

Senator SMATHERS. What is the cost of magnesium sulfate and sodium sulfate in the quantity of the packages which we see that AD–X2 is packaged in? What would that amount cost commercially?

Dr. ASTIN. I think I have some data on that.

At wholesale rates, the sodium and magnesium sulfates that are in a $36 carton of the material could be purchased for 5 cents.

Senator SMATHERS. Can be purchased for how much?

Dr. ASTIN. Five cents.

Senator SMATHERS. Five cents. Is that magnesium sulfate and sodium sulfate?

Dr. ASTIN. Yes, that is magnesium sulfate and sodium sulfate.

Senator SMATHERS. So that amount could be purchased for 5 cents?

Dr. ASTIN. At wholesale rates.

Senator SMATHERS. At wholesale prices?

Dr. ASTIN. That is right.

Senator SMATHERS. Do you recall how much Mr. Ritchie gets for his AD–X2, what he asks for that?

Dr. ASTIN. It is $3 a treatment package, and it is my recollection that a 2-pound carton, which contains a dozen packages, is $36.

Senator SMATHERS. Now, do you have any idea as to what the cost of the 7 mysterious trace elements is in 1 of these packages?

Dr. ASTIN. That would be very difficult to estimate. In the first place, these occur in percentages of one hundredth of a percent or less, and also most of these trace elements are usually found in the sodium and magnesium sulfates as you buy them, so that for the most part, the trace elements in the material are not unique trace elements. That is, you will get them in sodium and magnesium sulfate, anyway.

Senator SMATHERS. So just looking at these ingredients factually and coldly and as to their cost, you would say that the cost to reproduce that package, in ingredients, would amount to about 5 cents?

Dr. ASTIN. That is correct.

Senator SMATHERS. That would be your opinion.

Now, Doctor, as the Director of the Bureau of Standards, you consider it your duty, I presume, to report the facts irrespective of whom it might hurt; is that correct?

Dr. ASTIN. That is correct.

Senator SMATHERS. Yesterday there was some mention made of the fact that you might be injuring some small-business man. Do you think that you have an equal duty to protect the small consumer?

Dr. ASTIN. I don't know that we can relate our functions to either protecting or helping the consumer directly. That is, we are a scientific laboratory, and our primary purpose is to serve science and industry, to make the calibrations with respect to our standards, to determine information about the fundamental properties of materials, and so on. And this is a straightforward scientific operation, and I think that those data should be presented. They belong to the public. When we have information about properties of material, then the information should be given to the public.

Senator SMATHERS. Now, there was some point made that reasonable people could possibly have assumed that there was some motive behind the tests run by the Bureau of Standards because there were no circulars put out on additives from 1931 up until 1949. Do you care to comment on that?

Dr. ASTIN. Yes. In the first place, in 1948, when consideration was first given to the revision of this circular that we had been distributing on battery additives, some 17 years elapsed, so that the general reaction to it would be, I think, from people who received it, asking, "Well, have there been recent developments?"

That was one factor. Another factor is that following World War II, there was a considerable increase in the number of these materials appearing on the market, and also in 1948, we carried out an extensive study for the Bureau of Aeronautics on a whole variety of materials which we formulated in attempting to improve the storage characteristics of batteries. And in this connection, sodium and magnesium sulfates were also investigated.

In 1947, we investigated 5 new additives that had appeared on the market; in 1948, 2 additional ones, and also this investigation for

the Bureau of Aeronautics. So we were confronted in 1948 with having a large number of additional observations on these materials, and I think it is quite logical that at that time consideration should have been given to disseminating this information to the people interested in it.

Senator SMATHERS. Now, it has been stated that the Bureau of Standards operated improperly, we will say, in mentioning the name of AD–X2. I wonder if you would state how many times AD–X2 was specifically mentioned by the Bureau of Standards and under what circumstances.

Dr. ASTIN. AD–X2 was specifically mentioned by the Bureau in 2 communications to the National Better Business Bureau; I think 1 in 1949 and 1 in 1950. In 1950, permission was given the National Better Business Bureau to use the data with respect to the name in a bulletin the National Better Business Bureau was going to circulate to groups that it serves.

Senator SMATHERS. May I interrupt you there to ask you this question? Then the Bureau of Standards itself only mentioned the AD–X2 in a letter to the National Better Business Bureau; is that correct?

Dr. ASTIN. That is correct. The subsequent dissemination of the information was the responsibility of the National Better Business Bureau and not the National Bureau of Standards.

Then the material was mentioned again by name in the communications to the Members of the Congress who wrote about it, and then it was mentioned again by name in the report we made to the House Interstate and Foreign Commerce Committee in February of this year.

Senator SMATHERS. Did you at any time feel that you were violating any proprietary rights or violating any rules or regulations by mentioning the name of AD–X2 to the House Interstate and Foreign Commerce Committee?

Dr. ASTIN. We were asked to comment to them specifically on that problem because we had been questioned about the report released by this committee the preceding December in which the material was specifically named.

Senator SMATHERS. And why did you specifically name it to the National Better Business Bureau? Why did you then name AD–X2?

Dr. ASTIN. First because they requested it, and I understood that they requested it because claims had been made that the material should be exempted from general conclusions about the sodium and magnesium sulfate additives, and second, because claims had been made that the National Bureau of Standards had not tested the material. Both of these claims were erroneous, and because they were erroneous, we felt that it was proper that the name be mentioned.

Senator SMATHERS. Do I understand you to say, in effect, that you mentioned the name AD–X2 in the nature of a response to a question about AD–X2?

Dr. ASTIN. We have not of our own volition named the product at all. I think that one will find, if the record is checked completely, that every time we have referred to it, it has been in an attempt to answer some question about it from various groups.

Senator SMATHERS. Does the legislation which sets up the Bureau of Standards authorize you to disseminate such information?

Dr. ASTIN. Yes. I read yesterday the section of our basic act which authorizes us to do that. I believe it reads that we are authorized to disseminate results obtained from our operations when such data are of interest to scientific or manufacturing interests or to the general public.

Senator SMATHERS. Now, Doctor, in this test which the Bureau of Standards ran, were the results of that test confirmed subsequently by tests run by the Army Signal Corps?

Dr. ASTIN. The Army Signal Corps tests, I believe, were the first tests run by a Government agency on AD–X2. That is, our tests were subsequent to theirs.

Senator SMATHERS. Were the results of the Army Signal Corps tests the same as yours?

Dr. ASTIN. They were the same to the extent that they found no advantage for the material, no beneficial action.

Senator SMATHERS. Were the tests for the Navy shipyard at New York run prior to or subsequent to your Bureau of Standards test?

Dr. ASTIN. I believe they were also prior to it. I would have to check that.

Senator SMATHERS. Never mind. What were the results of the tests of the Navy shipyard? Were they the same as the Bureau of Standards?

Dr. ASTIN. Yes. They had no beneficial results.

Senator SMATHERS. Were the tests at the Detroit Arsenal of the United States Army Ordnance run prior to or subsequent to the tests run by the Bureau of Standards?

Dr. ASTIN. I believe all those tests were run prior to these tests.

Senator SMATHERS. And were the results of the tests run by the Detroit Arsenal of the United States Army Ordnance the same as those run by the Bureau of Standards?

Dr. ASTIN. The testing procedure was different, but they were the same in that they found no beneficial results from the material.

Senator SMATHERS. There has been some testimony about a Post Office fraud order being placed against the owners of AD–X2. What has the Bureau of Standards had to do with that fraud order, if anything?

Dr. ASTIN. We carried out a test for the Post Office Department to attempt to determine if the material complied with the claims made for it by its manufacturer. And we wrote a report to the Post Office Department furnishing the results of our laboratory tests. The subsequent interpretation of that in connection with fraud is and has been the responsibility of the Post Office Department.

Senator SMATHERS. In your letter detailing results of your findings, did you recommend that a fraud order be entered?

Dr. ASTIN. No. We never make such recommendations.

Senator SMATHERS. The only record——

Senator SPARKMAN. Would you yield to me for just a second?

Senator SMATHERS. Surely.

Senator SPARKMAN. You were asking about the dates of those tests. I have them before me. I thought it might be well to put the dates in the record here.

Senator SMATHERS. All right.

Senator SPARKMAN. The only Signal Corps test was May 23, 1949. That was the report, the conclusions of it. The Navy shipyard at New

York: the final report was February 23, 1949. The Detroit Arsenal: the report was dated September 23, 1949. The first test made by the Bureau of Standards, the preliminary tests were 2: January 26, 1949, to June 29, 1949; August 8, 1949, to March 31, 1950.

Senator SMATHERS. Thank you very much, Senator.

Now, in the letter of findings which you wrote to the Post Office Department, I did not get your answer. Did you say you did or did not make any recommendation as to what should be done?

Dr. ASTIN. No. We make no recommendations.

Senator SMATHERS. You never make any recommendations; is that correct?

Dr. ASTIN. That is our procedure, not to make recommendations.

Senator SMATHERS. So, if a fraud order has been entered, it is not because of the Bureau fo Standards; it is because of the Post Office Department; is that correct?

Dr. ASTIN. That action is theirs; that is true. However, the laboratory data which we furnish them may provide the basis for the action they take.

Senator SMATHERS. But it is up to the Post Office Department to draw ther own conclusions from the facts which you present?

Dr. ASTIN. That is correct.

Senator SMATHERS. In other words, to go back, you people consider yourselves scientists and not either prosecutors or salesmen; is that correct?

Dr. ASTIN. That is absolutely correct.

Senator SMATHERS. You do not feel that you should enter the hassle in the market place, so to speak?

Dr. ASTIN. We have no competence in that area.

Senator SMATHERS. Now, yesterday there was a letter read, written by Mr. H. A. Harvey, of the Auto-Lite Battery Corp. I wonder if I could get a copy of that letter.

Mr. Chairman, I do not recall whether the whole letter or whether just one paragraph is in the record.

The CHAIRMAN. It was the second paragraph that was read. But the entire letter was put in the record.

(Letter referred to appears on p. 241.)

Senator SMATHERS. Thank you, Mr. Chairman. The letter is to Mr. Craig R. Sheaffer, Assistant Secretary of Commerce for Domestic Affairs, and it is signed by Mr. H. A. Harvey, the vice president of the Auto-Lite Battery Corp. It is all in the record, but I would like to read for the record the last paragraph of this letter. The paragraph which was read yesterday said:

> Chemical analysis of AD–X2 shows that it consists primarily of magnesium and sodium sulfates, like most of the hundred or more products with similar claims which have appeared on the market during the past 40 years. It is well known to battery engineers that magnesium and sodium sulfate help to dissolve impervious lead sulfate which may render batteries inoperative as sulfated batteries.

Then it goes on to discuss the matter of lead sulfate in batteries. It comes on down to the last paragraph, which says:

> Mr. Jess M. Ritchie, promoter of AD–X2, appears to be an accomplished psychologist and politician. I am inclined to think that it is these qualities rather than the merit of his product which underlie the furor which he has caused with AD–X2.

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I would like to be certain that that all gets into the record.

Mr. Chairman, no further questions.

The CHAIRMAN. Dr. Hunt, you were not given an opportunity yesterday to ask any questions. So we will turn to you, Senator.

Senator HUNT. Thank you, Mr. Chairman.

Dr. Astin, in your examinations of ingredients that are submitted to you, I assume that aside from the making of your various tests with reference to whether they will do those things which the advertiser says they will do, you also make a chemical analysis of the ingredients; is that correct?

Dr. ASTIN. Yes, sir.

Senator HUNT. Now, in making a chemical analysis of the various ingredients of AD–X2, could you tell me whether it differs any from the so-called Protecto-Charge, which was the name of the other commodity, or manufactured or compounded ingredient? Do you know if there is any chemical difference in the elements of those two mixtures?

Dr. ASTIN. To the best of my knowledge, we have never analyzed a material coming out of a package with the label "Protecto-Charge" on it. It is my recollection that the only tests we have run on this material have been from samples carrying the name, "AD–X2." So we are not in a position to say whether AD–X2 is different from Protecto-Charge.

Senator HUNT. You have not run any tests on Protecto-Charge?

Dr. ASTIN. We may have, but I am not familiar with them. I doubt that we did. We have, however, run a number of analyses on different samples of AD–X2.

Senator HUNT. Doctor, I think it would be helpful to the committee if you could tell us why in the 48 various manufactured products that you have tested, consistently magnesium and sodium sulfate are the basis of those concoctions. Why are they so universally used if they do not have some beneficial effect?

Dr. ASTIN. The electrolyte in an ordinary lead-acid battery is a solution of sulfuric acid. When sulfuric acid is dissolved in water, it separates into ions. That is, sulfuric acid is composed of hydrogen and a sulfate group, which consists of sulfur and oxygen. The hydrogen half of the sulfuric acid molecule separates and carries a positive charge, the sulfate half carries a negative charge.

Now, this separation is basic to the process that makes the battery work. There has been a feeling among a lot of people trying to improve batteries that if one increases the density of sulfate ions in the battery, beneficial effects might be obtained.

Now, sodium and magnesium sulfates when dissolved in water also separate into ions, as does the sulfuric acid, and one gets from this solution an increase in the density of the sulfate ion. And the reason sodium and magnesium sulfates are used rather than other types of sulfates, like copper sulfate, is that sodium and magnesium sulfates apparently cause no harm due to the presence of the sodium and magnesium ions in the electrolyte.

This, of course, is a technical question, and it is difficult to clarify it. But that is about as simple as I can make it, I think.

Senator HUNT. Thank you.

Doctor, I want to ask you, in the addition of AD–X2 to batteries, as I understand it, there is also a battery service connected with the

selling of the product. Now, as I understand it, these batteries are taken apart; sediment is removed from the bottom; buckled and worn-out plates are replaced; worn-out separators are replaced; any short circuits are corrected; a new acid solution is put in, and then the AD–X2 is added.

Now, in your experiments in your laboratory, did you give that service to the batteries that you treated, or did you simply put in the additive?

Dr. ASTIN. In some cases the batteries were reconditioned; in others, the additive alone was added without any further servicing.

Senator HUNT. All right. Now, will you tell the committee——

The CHAIRMAN. Might I interrupt at that point? Was it my understanding of the question asked by the Senator that all the service stations that sell the AD–X2 give this general service to the battery before the AD–X2 is applied? Was that the basis of your question?

Senator HUNT. That was the basis. I would not say "all." My information is that Mr. Ritchie sells not only the substance, Battery AD–X2, but also a reconditioning service known as the Battery AD–X2 service system. Such a reconditioning service is found to help any battery.

The CHAIRMAN. The only reason that I am asking the question is to make certain that the record is clear on that. Are we to understand from your question that this is a general service rendered at all the sales organizations and establishments that sell the AD–X2?

Senator HUNT. I would not think it would be all the sales, because I think it would be impossible for Mr. Ritchie to do this servicing in all of the various parts of the country where his product is sold.

The CHAIRMAN. That was what led me to ask the question, because I want to be certain that the record would be clear on the question as to whether that was a general function of all the service stations on a battery prior to the sale of the product.

You have asked a question leaving the record to appear as if this service was always made prior to the application of the AD–X2 compound. I just want the record to be perfectly clear on that question, sir.

Senator HUNT. My statement was that Mr. Ritchie sells not only the substance but a service. I did not intimate that it was always used or that it was never used.

The CHAIRMAN. I just wanted to be sure that the question was separated in such a manner that we would be able to frame the question to Mr. Ritchie, because I know nothing about how it is sold or how a battery station services the battery prior to the application of AD–X2. I just want to develop the record clearly on that question.

Senator HUNT. Doctor, in the event that full use is made of the service as well as the additive in the same battery, what percent of improvement in the battery do you think would be from the service and what percent of improvement would be from the additive?

Dr. ASTIN. If there is any improvement, I would say it would be 100 percent from the service and zero percent from the additive.

The CHAIRMAN. In order that the record may show this question, if we must refer to it at a future time, was there any service given to batteries of the fleet operators that had continuously ordered the product over a period of several years? Was there a service rendered

with the AD–X2 product to these fleet operators, or did the fleet operators just make the application without any service whatsoever?

We may have this question on the record, and we will get the answer to it at a later time.

Senator HUNT. I think you could get that answer, of course, from a fleet operator.

The CHAIRMAN. Definitely.

Senator SMATHERS. May I just make this observation, Mr. Chairman? I think a minute ago it was established that always, with AD–X2, they at least give it a charge. They do not just pour in the AD–X2 and just leave it there.

The CHAIRMAN. In order that the record is clear, this is assuming that a fleet operator, operating 500 or 600 either trucks or motors that used the storage battery, in the event he makes an application of AD–X2, could make that application without ever removing the battery from the unit, and that he just simply puts the AD–X2 in and continues the operation.

Senator SMATHERS. That is what I originally thought. But I think that subsequent investigation has revealed that on the directions either they run the engine of the car way up, which has the effect of recharging the battery——

The CHAIRMAN. The Senator is not exactly familiar with the automatic controls of your mechanism on your generator. If a battery is full, it automatically kicks out, and if a battery is low, it will automatically take the full charge of the generator. You could run a motor as fast as you like, if a battery is full, and your automatic controls will not put any more juice in that battery, because if it did, you would burn the battery. That is an automatic device in the generator.

Senator SMATHERS. I think that they have a regulator on the generator, I believe, which actually governs what goes into it. Now, I do not know. I am in a field where I am completely lost. But as I recall from the testimony that has been given, every time AD–X2 is used, there is always something that goes along with it. Either the charge is given by the operators or the reconditioning process goes with it, or it is taken out and reworked.

The CHAIRMAN. The only reason for developing these questions as I did with Senator Hunt was that there will be men who will appear later to testify who are either the battery-station operators or the fleet operators, and they now have the questions in the record, to which they will give us the positive, everyday usage in reply.

So, Senator Hunt, you will pardon be for interrupting. You may proceed.

Senator SPARKMAN. May I say at this point that you will recall that Mr. Ritchie himself testified that the additive was more or less a cleanser and that it had nothing to do with the charging. You still had to charge the battery after the additive was put in.

Senator HUNT. Dr. Astin, would you tell the committee the names of the two men, I believe, primarily, who did the greatest amount of work on these investigations in your laboratory?

Dr. ASTIN. The two men who did the greatest amount of work initially were Dr. George Vinal and Mr. Paul Howard.

Senator HUNT. And did you have every confidence in their ability, or were they under your jurisdiction at any time?

Dr. ASTIN. They were not under my jurisdiction. Dr. Vinal retired in 1949 and was never under my jurisdiction. Mr. Howard resigned about a year ago. He was a couple of stages removed from my jurisdiction. That is, he was not under my direct supervision. But at the time they did the work, neither of them was under my jurisdiction.

Senator HUNT. Do you know them by reputation sufficiently to feel that their work is competent and accurate?

Dr. ASTIN. I have complete confidence in their competence, their reliability, and their objectivity.

Senator HUNT. Where are those gentlemen now, Doctor?

Dr. ASTIN. Dr. Vinal, as I said, has retired. He is living in Princeton, N. J., and doing occasional consulting work for the Radio Corporation of America and the Electric Storage Battery Co. Mr. Howard is working for the Yardney Electric Co. in New York City.

Senator HUNT. Could you tell the committee how it happened that, following their retirement from the Bureau of Standards, they became connected with battery companies?

Dr. ASTIN. That is a very natural thing for them to do. Dr. Vinal, as one of the country's and one of the world's outstanding battery authorities, apparently did not want to be completely idle after his retirement, and in order to make most effective use of his skill, the type of organization he could serve best would be a battery company. I think it is completely logical that he have such an association, and I personally feel very strongly about aspersions which have been cast that there is something wrong with his doing this work. I believe that it would be important when people attempt to infer that there is something wrong about it that the motives of the people who make such inferences ought to be looked into.

A similar situation applies with Mr. Howard. He has not as long and as distinguished a career as Dr. Vinal. He is a younger man, but his skill also is in batteries. He had worked with battery groups before he came to the National Bureau of Standards, and it is quite logical that if he wanted to leave the Government service, he would go to work for some battery company.

Now, incidentally, the company he is working with is a manufacturer of alkaline batteries, which, to some extent, are competitive batteries to the lead-acid batteries.

But we have demands from industry all the time attracting people from the Bureau to go to work in private industry. I think most of the members of our organization could leave tomorrow and accept a position in industry at substantially more than they are making working for the Government. But our people believe in the importance of the work they are doing. They think that there is a certain pleasure and virtue and patriotism in public service, and we are able to keep outstanding scientists in our organization at salaries substantially less than they could get in private industry. Occasionally, one of them gets tempted and will go out and increase his salary and increase his pleasure from the material benefits of life rather than from the spiritual.

Senator HUNT. You take the position, then, Doctor, that it is entirely unfair to these two scientists to cast aspersions or intimate that they have gone with battery companies as a payoff for the work they did in the Bureau of Standards on AD–X2?

Dr. ASTIN. I think it is very unfair; yes, sir.

Senator HUNT. Doctor, when Secretaries Weeks and Sheaffer appeared before us with reference to discharging you, they said you were not sufficiently objective in the market place. You entirely discount the play of the market place.

How would you interpret that statement?

Dr. ASTIN. That may be due to a misunderstanding, sir. However, we are a scientific laboratory. We attempt to determine technical merits; and use consideration, that is, whether a person is satisfied by the use of a product, bears no consideration in influencing our findings. If, however, market-place factors create interest in a product, then that might determine whether or not we would investigate it. But certainly the customer satisfaction or the demand for a particular product in the market has no bearing whatsoever on the technical merits of a product.

Senator HUNT. Doctor, does your institution examine the quality of a manufactured product such as the Sheaffer ballpoint fountain pen?

Dr. ASTIN. To the best of my knowledge, we have never tested it.

Senator HUNT. You, then, have had no communication with the Federal Trade Commission whereby the Federal Trade Commission forced the Sheaffer Pen to discontinue the advertising of their ballpoint pen as a lifetime ballpoint pen?

Dr. ASTIN. I have no information that we ever furnished any advice or assistance to the Federal Trade Commission in that connection.

Senator HUNT. Thank you, Mr. Chairman.

The CHAIRMAN. Senator Ferguson, of course, has been conducting hearings on the Armed Services Subcommittee of the Appropriations Committee; therefore, his schedule has been exceedingly heavy and difficult to adjust. For that reason, I will pass over any of the others to permit Senator Ferguson to ask questions at this time.

Senator FERGUSON. I have a few questions, Doctor, that I did want to ask, and I appreciate the Chair and the other members of the committee permitting me to intervene at this time.

The CHAIRMAN. I would say, Senator Ferguson, that Senator Schoeppel last evening had not completed his questioning at the time that we recessed, and that was the reason I was passing over him, to permit you the opportunity to question the witness right at this time.

Senator FERGUSON. I left the Armed Services Subcommittee of the Appropriations Committee, and would like to ask just a few questions to get an understanding of this situation as far as you are concerned, Doctor. You were connected, were you not, in the chain of authority at the time that this proceeding was going on as far as this battery additive was concerned?

Dr. ASTIN. I got into it in the summer of 1951.

Senator FERGUSON. 1951?

Dr. ASTIN. Yes, sir.

Senator FERGUSON. Were you in the chain of command prior to that time?

Dr. ASTIN. I was not.

Senator FERGUSON. So, then, you would be in the chain of command from 1951?

Dr. ASTIN. That is correct.

Senator FERGUSON. Were you in the chain of command and in authority at the time the matter was taken over to the Post Office?

Dr. ASTIN. Yes. We submitted reports to the Post Office Department when I was responsible for the organization.

Senator FERGUSON. Did you personally go over to the Post Office authorities?

Dr. ASTIN. I appeared, at their request, at a hearing they held in October 1952.

Senator FERGUSON. Their proceeding was solely for the purpose of ascertaining whether or not this company was using fraud as far as the mails were concerned; is that correct?

Dr. ASTIN. That is my understanding; yes, sir.

Senator FERGUSON. And did they subpena you or request you to come over?

Dr. ASTIN. They requested me to come over.

Senator FERGUSON. Was this in writing or not?

Dr. ASTIN. It is my recollection that there was a written request that we make members of our staff available to testify; and it is my recollection that my invitation was by telephone.

Senator FERGUSON. How many people went over with you?

Dr. ASTIN. I think there were about 5 or 6 members of the staff testifying.

Senator FERGUSON. Were there not nine?

Dr. ASTIN. There may have been. I don't remember.

Senator FERGUSON. How many postal inspectors were there who would be the people that were really running the proceeding to get the evidence?

Dr. ASTIN. At the hearing, I don't remember exactly, sir. I think there were 2 or 3.

Senator FERGUSON. Had you ever been over before on any project with respect to the mails?

Dr. ASTIN. No. That was the first time.

Senator FERGUSON. The first time. Was this not unusual to ask you, as the director of research, to come over when they were considering whether or not a company was using the mails to defraud?

Dr. ASTIN. They were interested in learning the results of the tests carried out in our laboratory and in having some clarification of the conclusions in the reports. Normally, I would say it would be unusual, but they were also using in their hearing, so I understand, data taken on the tests we ran on this product, AD–X2, in June 1952, and I had been associated very closely with that particular test. I think it is because of my close association with that test that they asked me to appear.

Senator FERGUSON. Doctor, do you know of any other case that became as important in the various agencies as this battery additive case?

Dr. ASTIN. No; I do not.

Senator FERGUSON. No other one ever took on the importance that this case did, where they even had the director in the act, as we call it; is that right?

Dr. ASTIN. I am not familiar with one.

Senator FERGUSON. You are not familiar with one. Now, how do you account for this becoming a celebrated case? That is not going into the new administration at all.

Dr. ASTIN. That is correct.

Senator FERGUSON. This was back under the other administration. How did this become a celebrated case back under the other administration?

Dr. ASTIN. I think it would be better if you asked the Post Office Department representatives to answer that question. But I can perhaps give some hint. It is my understanding that the Post Office Department first planned to hold hearings on this matter in the spring of 1952. It is also my understanding that they were requested to defer the hearings by representatives of the Senate Small Business Committee until the Bureau completed its tests that they carried out in June of 1952, and the Post Office did comply with that request and deferred its hearing accordingly. So I would say that there was—well, I don't know how many cases of that sort the Senate Small Business Committee gets into, but I would guess that there was unusual interest both ways.

Senator FERGUSON. I did not happen to be a member of the Small Business Committee last year. I am interested, though, in why this became a celebrated case; why, because the Small Business Committee was in it, this pressure, this activity of the various departments took place. Was it because Congress was investigating this matter?

Dr. ASTIN. It may have been. I am familiar with no tests we have run at the National Bureau of Standards which developed as much interest in Members of Congress as the tests we have run on this material.

Senator FERGUSON. And do you know of any case, before it got out in public, that created the same interest?

Dr. ASTIN. Right now I am not familiar with one.

Senator FERGUSON. All right. Now, let us go to when you were seeking advice from the Better Business Bureau. Can you tell us of any other case where you ever sought the advice on what should go into a report—as, for instance, in 1950, in the letters to the Better Business Bureau, as I read them, where you say you want to know the legal aspects or the legal complications of issuing statements regarding AD–X2?

Senator SMATHERS. Mr. Chairman, just to correct the record——

Senator FERGUSON. Yes; if it is not right.

Senator SMATHERS. You say "you." As I understand it, Dr. Astin did not write such letters.

Senator FERGUSON. No. His Department wrote them, and he was in command at the time. I am trying to find out what took place about this celebrated case, and why it became celebrated.

You were the gentlemen over on that side who were investigating it at that time.

Senator SMATHERS. There were 28 Senators apparently who took great interest in it. So, maybe that would explain some of the reasons why there was this hassle over there about it.

Senator FERGUSON. That may have been why these departments are going to show the Senators that they had authority and that they would do as they pleased. That may have been the reason. We may find that is the reason; that because the Senate got into it, it was a great detriment to have the Senate in it. In my experience, I have found that.

The CHAIRMAN. Let us not make this a personal argument. Let us just confine it to questions of Dr. Astin.

Senator FERGUSON. All right.

Dr. ASTIN. To answer Senator Ferguson's question, or to try to answer it, we frequently attempt to determine the interest of scientific and manufacturing groups in publications before we distribute them. In my general statement yesterday, I made reference to one such example on a circular we put out on hearing aids. And since our act specifies that publications should be related to scientific and manufacturing interests, we do make a serious effort to determine the degree of interest in information of a particular type before dissemination.

Senator FERGUSON. Is Mr. Ritchie, the owner of this product, correct in saying that no complaint was ever filed with you or the Post Office by a consumer or a user of this product?

Dr. ASTIN. That is right. We have no function of receiving Post Office complaints.

Senator FERGUSON. All right. None was ever filed with you; is that correct?

Dr. ASTIN. That is correct.

Senator FERGUSON. Do you know whether any was ever filed with the Post Office?

Dr. ASTIN. No, I cannot answer that, sir.

Senator FERGUSON. All right. Now, do you know of any other case where you sought the advice of the Better Business Bureau, the National Better Business Bureau, as to the legal aspects or the legal complications of using a statement that you would make, or that your Department would make?

Dr. ASTIN. No; I know of no other case where that particular type of advice was sought.

Senator FERGUSON. All right. Now, do you know of any other case, from anybody else, whether it was the National Better Business Bureau or anyone else, in which you sought outside advice on the legal aspects or the legal complications of using a statement?

Dr. ASTIN. No; I do not know of any.

Senator FERGUSON. How do you account for doing it back in 1950 in this case? Was that before the Congress got into the matter?

Dr. ASTIN. There was very little congressional interest in it at that time. I think the only Senator at that time who had written to us was Senator Knowland.

Senator FERGUSON. The Small Business Committee had not been in on it?

Dr. ASTIN. No; it had not.

Senator FERGUSON. So, prior to the time that the Small Business Committee came into it, you, or your Department, rather, sought the advice of an outside agency. Now, will you explain why?

Dr. ASTIN. I attempted to explain why we very frequently seek the advice of outside agencies on publications. It is in order to determine their degree of interest. As to why advice was sought on the legal aspects of the case, I am not sure.

I think it might have been more appropriate if any legal considerations were involved, to have asked the Solicitor of the Department of Commerce. And that probably was done, anyway.

Senator FERGUSON. Now, Doctor, in scientific investigations, do you ever find any in which you cannot explain why certain things happen?

Dr. ASTIN. Oh, yes; frequently.

Senator FERGUSON. Do you ever try to work backward and say that this does it; now, we would like to find out why it does it?

Dr. ASTIN. Oh, that happens every day.

Senator FERGUSON. That happens every day?

Dr. ASTIN. Yes.

Senator FERGUSON. You know, the scientists have said that a bumble bee cannot fly. You realize that.

Dr. ASTIN. I do not think any scientist has said that.

Senator FERGUSON. You do not think so?

Dr. ASTIN. No.

Senator FERGUSON. Well, you know the customers in this case say that this works. Have you ever thought of taking that as a premise?

Dr. ASTIN. Yes. I think that that has been a factor in many of our investigations. But——

Senator FERGUSON. No, no. In this one, did you take as a premise that no customer was saying that this did not work, and many customers were saying, or consumers, that it did work?

Dr. ASTIN. If it works, then it must have some effect on the performance of a battery. It is possible to measure battery performance with laboratory instruments. We have been able to measure no effect of this material on battery performance, no significant effect that we can measure.

Senator FERGUSON. Now, here you had no customer, no user saying that it did not. But as the evidence shows—and I may be wrong on this—it may not all show this—it did work as far as the users were concerned, and produced good effects. Why did you not take that as a premise as being one of these things that maybe works even though as a laboratory tester you could not determine that question?

Dr. ASTIN. The fact that an unskilled observer says it works does not mean anything from a technical point of view.

Senator FERGUSON. Did you ever hear of the saying that the proof of the pudding is in the eating?

Dr. ASTIN. Yes, sir.

Senator FERGUSON. Couldn't this be the case?

Dr. ASTIN. The proof of the pudding——

Senator FERGUSON. Is in the use of it?

Dr. ASTIN. The proof of the pudding is in the use. But I have seen no information that the use yields data which proves conclusively that it is valuable.

Senator FERGUSON. You want to say that the users must prove conclusively. Do you think that is a fair assumption, that he must prove conclusively?

Dr. ASTIN. They must have some measurements, some consistent, logical measurements before their observations could be taken as establishing that the material is beneficial.

Senator FERGUSON. Now, do you not think, when a man who uses a battery and pays to put something in it and then claims that it works, that that ought to be considered as to whether or not the man who is selling it to him has committed a fraud on him? What is fraud in your opinion? You were helping to get a fraud order.

Dr. ASTIN. I am not an expert on fraud, sir. We determine merely the performance of materials and devices as far as this is concerned. Now——

Senator FERGUSON. Doctor, were you not consulted as to whether or not a fraud order should be issued by the Post Office Department against the citizen? And were you not giving your advice that in your opinion it should be issued because scientifically this would not work, or give any beneficial result?

Dr. ASTIN. We gave advice on the latter, that there was no evidence that the material conformed to the claims, that is, no technical evidence that the material conformed to the claims made for it. But——

Senator FERGUSON. But suppose actually it did; is that not the test on a fraud order? Not whether scientifically—and you have told us that you cannot tell scientifically whether a thing will work or not in many cases——

Dr. ASTIN. No; that is not quite the same thing, sir.

Senator FERGUSON. That is what I was led to believe.

Dr. ASTIN. Your question as I understood it before was, Can we explain why things work?

Senator FERGUSON. All right. Now, can you explain——

Dr. ASTIN. The question is, Can we tell, does it work? That is quite different. If this material does in fact improve the operation of a battery, then it should be possible to measure that improvement. We have not been able to measure any improvement in the performance.

The CHAIRMAN. For the information of all, there will be users who will testify later in the hearing, and they likewise will be under oath, so that it will not be a sales talk.

Senator FERGUSON. Doctor, can you tell us now scientifically why a battery works at all?

Dr. ASTIN. I think I can give a pretty good explanation; yes, sir.

Senator FERGUSON. All right. Will you do it?

Dr. ASTIN. Well, I will try and do it.

One of the first characteristics or features as to why a battery works is that salts, compounds of materials formed of two groups of atoms, separate into ions in solution. Now, the ions are atoms or groups of atoms which carry a charge, so that one has in this solution—and it can be either a solid solution, as in a dry cell, or a liquid solution, as in a storage battery—these ions. These ions, because of their electrical characteristics, have an affinity in varying degrees for other different types of atoms.

Now, one then puts the next ingredient in a battery, electrodes. The material of which the electrodes are made is an important characteristic determining the affinity of the ions in the solution toward the electrodes.

Now, if one gets a proper composition of ions in a solution and electrodes at the terminals, one can cause a migration of ions carrying a positive charge to one electrode, ions carrying a negative charge to the other electrode, and by this means, one converts—then at the electrode, the ions give up the charge they are carrying and combine chemically, usually with something on the electrode, and through this process, chemical energy is converted into electrical energy, and that is about as simple as I can make it.

Senator FERGUSON. All right. Now, you say they do carry it. Now, you tell us why they carry it, why this particular solution carries it?

Dr. ASTIN. There are various explanations——

Senator FERGUSON. And why no other solution will carry it.

Dr. ASTIN. Well, other solutions do.

Senator FERGUSON. Then why won't the Ritchie one carry it?

Dr. ASTIN. Well, the Ritchie thing adds to the concentration of the sulfate ions in the battery, but it has no significant effect on the performance of the battery. That is, putting the material in there does not influence in any appreciable way the migration of these ions to the various electrodes.

Senator FERGUSON. Well, the testers, the chairman has indicated, are going to come in here, some of them, and say that the actual test, the proof of the pudding, again, is in the use or the eating of it. Do you now say that you cannot find that it does? Could it, without your finding it, scientifically finding it?

Dr. ASTIN. I think it is extremely unlikely that it would have any effect on the battery performance which we have missed in our search for something.

Senator FERGUSON. Doctor, did you conduct these tests personally?

Dr. ASTIN. No, I did not. But I have the utmost confidence in our staff, and we have actually tried to find some beneficial action for this material.

Senator FERGUSON. Did you find any detriment?

Dr. ASTIN. A very trivial detriment.

Senator FERGUSON. When did you find that detriment?

Dr. ASTIN. This first became apparent in the analysis of some of our data and tests that we made this past January.

Senator FERGUSON. Now, in the first test, you did not find any detriment?

Dr. ASTIN. That is right.

Senator FERGUSON. And in the January tests you found that there was some detriment?

Dr. ASTIN. A trivial one.

Senator FERGUSON. How much of a detriment?

Dr. ASTIN. Well, it is difficult to express it in quantitative terms. One of the things that happens is that the addition of this material lowers the electrical conductivity of the battery under normal operating conditions by 5 percent. Now, this might conceivably be an important characteristic in a battery that would just barely start a car—that is, it might under very special conditions make the difference between the ability of a battery to start a car or not. However, in normal operation nobody would ever be able to notice the effect of it. That is one of the characteristics.

Another is that in the charging process—that is, the converting of the electrical energy to chemical energy to restore the battery to its charged state—these materials lower the efficiency of the charging process by a very small percentage.

Senator FERGUSON. Doctor, do you know of any reason why a battery manufacturer should withdraw all guaranties if you put this additive in?

Dr. ASTIN. I know of no technical reason for his withdrawing his guaranty for putting this material in. But I understand that some of them have such a requirement and I think that is done largely to prevent really harmful materials being put in. There have been——

Senator FERGUSON. Do you think it is fair, as a scientist, for a manufacturer to withdraw all guaranties on their product if the buyer uses

a product such as this AD–X2? Is that not intimidating the buyer?

Dr. ASTIN. It might be construed as intimidating——

Senator FERGUSON. What do you say as a scientist? Do you think it is a fair proceeding?

Dr. ASTIN. Well, it could be justified from this basis: that the lack of harm would have to be established if the manufacturer allowed any exceptions. Now, the fairest procedure, of course, would be to let the owner do anything he chooses to the battery as long as he did not harm it. But then there would be the question of this deliberate harm coming in which would have to be proved. Now, that would be the fairest way to do it—that is, from my point of view. But it might be impractical to do it.

Senator FERGUSON. Doctor, did you take into consideration in your tests the fact that all battery manufacturers, or practically all of them, forbid the use of this product in their batteries?

Dr. ASTIN. No. That has no relation whatsoever to our tests.

Senator FERGUSON. Did you know that they had?

Dr. ASTIN. I have been informed that some battery manufacturers have such a provision in their guaranties; yes.

Senator FERGUSON. In effect do they not say by putting that in their guaranty that this is harmful? Isn't that what it amounts to, to the public?

Dr. ASTIN. It amounts to the fact that it might be harmful. That is, I attempted to explain, the fairest way would be to let them do anything they want to it as long as it was not deliberately harmed. But when there is a possibility that some of these additives would be harmful, then I think it is a practical provision for the manufacturer to put it in. And many of these additives—and we have tested dozens of them over the last 30 years—many of them are harmful.

Senator FERGUSON. Now, Doctor, would you say that you found this harmful trace in January by virtue of more complete tests?

Dr. ASTIN. I would say more precise tests.

Senator FERGUSON. More precise tests?

Dr. ASTIN. That is correct.

Senator FERGUSON. All right. But then back in October when you had not made these precise tests, you appeared before the Post Office, and they issued an order of fraud against this man when there was not even any evidence of any slight hindrance or detriment; is that right?

Dr. ASTIN. That is correct.

Senator FERGUSON. Why had you not made the precise tests before you went over and at least gave your testimony in order to obtain, or for the Post Office to obtain, a fraud order against this individual?

Dr. ASTIN. If this effect, which appears to be a harmful effect, which we have uncovered——

Senator FERGUSON. Do you think it is a harmful effect?

Dr. ASTIN. Yes. It is a slightly harmful effect. If this effect were a beneficial effect of the same magnitude, it would be of no practical value, so that the thing could actually be reversed, but be so small as to perform no useful service in prolonging the life of a battery.

Now, this boils down to the precision with which we make our measurements. We were able to establish in our earlier tests that

these materials performed no practical beneficial effect on the battery. Now, when we got into more careful investigations as to the mechanism of this process, we found some minor effects, and they are so minor that even if they were helpful, they would be of no value.

Senator FERGUSON. They are almost negative?

Dr. ASTIN. Almost negative.

Senator FERGUSON. When were you first asked by the Post Office Department to investigate this, to make a test? And in what form was it? Is it in the record, could I ask counsel? Is the first request by the Post Office of the Bureau in the record?

Dr. ASTIN. The first request was September 6, 1951.

Senator FERGUSON. September 6, 1951?

Dr. ASTIN. That is correct.

Senator FERGUSON. What was their request?

Dr. ASTIN. They sent us samples of this material and asked us if we would investigate it in the laboratory to see if it conformed to certain claims which were made for it.

Senator FERGUSON. And did you do that?

Dr. ASTIN. Yes; we attempted to do that.

Senator FERGUSON. Now, wait. You attempted it. Did you do it?

Dr. ASTIN. I think we did; yes.

Senator FERGUSON. You did it. And when did you give them the results of your test?

Dr. ASTIN. We sent them a report on that test, to fulfill that request in December of 1951, but we had used to write that report data obtained from tests we had carried out about 2 years earlier on the same material. The legal experts in the Post Office Department decided that in order for our findings to be valid for their action, we would have to make tests on samples actually supplied by the Post Office Department. So then they requested a new series of tests which we ran last year.

Senator FERGUSON. Mr. Chairman, I would like to have, then, the original report, and I would like to ask to make part of the record the testimony, or the statement, that the doctor made to the Post Office authorities in their record when they obtained the fraud order.

The CHAIRMAN. Has that been furnished for the record with the previous documents?

Mr. FORSYTHE. It has not.

The CHAIRMAN. It has not been furnished?

Mr. FORSYTHE. No, sir.

Senator FERGUSON. I would like to have that made a part of the record.

(A copy of the transcript of Dr. Astin's testimony before the Post Office Department, October 14, 1952, on Battery AD–X2 case appears on p. 296.)

Senator FERGUSON. Now, you say the Post Office authorities were not satisfied with your first test?

Dr. ASTIN. That is true.

Senator FERGUSON. And they did what?

Dr. ASTIN. They were not satisfied, for legal reasons. That is, we had used the wrong sample.

The CHAIRMAN. That is customary? In other words, the postal inspectors had furnished you with a sample which they had confiscated in the mails?

Dr. ASTIN. That is correct.

The CHAIRMAN. And that is legal procedure? In other words, they must testify that this is what they took out of the mails, and therefore the report must be on the sample that they submitted in order that they comply with all regulations that they operate under?

Dr. ASTIN. That is correct. We failed to do that, and so we had to run tests.

The CHAIRMAN. How many cells was the sample that was submitted to you by the postal inspectors—how many cells was that sample used on in the test that was then run?

Dr. ASTIN. I believe I gave that information yesterday. I cannot put my finger on it right here, but it is——

The CHAIRMAN. Was that the three cells?

Mr. ASTIN. No, sir. According to my recollection, this was on 8 old batteries and 6 new batteries.

The CHAIRMAN. Eight old batteries?

Dr. ASTIN. Eight old batteries and six new batteries.

The CHAIRMAN. Then how many sample packages did the postal inspectors submit to you?

Dr. ASTIN. For these tests, that would have been 8 and 6; 14, times 2——

The CHAIRMAN. Now, you are counting back on the batteries?

Dr. ASTIN. That is correct.

The CHAIRMAN. I am counting what number of samples the postal inspectors had seized and had submitted to you as mail that they had seized for the purpose of running the tests. I do not want you to count back on the batteries. I could do that.

Dr. ASTIN. I don't know, sir——

The CHAIRMAN. But I want to know, now, because the inspectors were complying with regulations, seizing mail, and then asking you to run tests on that which they put under seizure. So I do not want you to count back on the batteries. I want to know the number of packages.

Dr. ASTIN. May I supply that for the record, sir?

The CHAIRMAN. Yes, the number of packages that were submitted to you by the postal authorities.

Dr. ASTIN. I will supply that for the record.

(In compliance with the chairman's request, Dr. Astin subsequently supplied the following information in letter of June 29, 1953, to the chairman:)

With the letter dated March 13, 1952, from Mr. C. C. Garner, chief post-office inspector (their reference, case 85372F), there was submitted 1 carton containing 1 dozen packages, each package containing 3 envelopes of battery AD–X2. The notation "CED 3/12/52" was stamped on the carton, each package, and each envelope. All the material submitted was used but the carton, packages, and envelopes were returned to the Post Office Department.

The CHAIRMAN. Thank you. You may proceed.

Senator FERGUSON. Doctor, a certain number of packages were given to you?

Dr. ASTIN. Yes, sir.

Senator FERGUSON. Were they given to you personally?

Dr. ASTIN. No, sir.

Senator FERGUSON. Were you consulted at the time they were given to the Department?

Dr. ASTIN. No, sir. This was a routine operation, and it is handled at the working levels.

Senator FERGUSON. Up to that time, had you had any direct connection with it?

Dr. ASTIN. Up to that time, I had had no direct connection with the testing work. I had been involved in attempting to answer some of the inquiries of Members of the Congress.

Senator FERGUSON. Do you think that the fact that Members of Congress were inquiring had anything to do with your testing?

Dr. ASTIN. I do not think so, sir.

Senator FERGUSON. Do you find any prejudice in the Department when Members of Congress inquire?

Dr. ASTIN. No, sir.

Senator FERGUSON. You do not find any at all?

Dr. ASTIN. No. We attempt to try to serve the Members of Congress in helping them to answer inquiries from their constituents.

Senator FERGUSON. Now, these Members of Congress that were coming to you, did you tell them that the post-office authorities had asked you for a new test? Did you keep the Members of Congress fully advised?

Dr. ASTIN. I cannot be sure whether we referred to the impending tests with the Post Office and Federal Trade Commission or not. I would have to check the correspondence.

Senator FERGUSON. Now, when did you get the samples to make the second tests?

Dr. ASTIN. I will give you that date exactly when I furnish for the record the number received. It is my recollection that it was the first part of 1950.

Senator FERGUSON. The first part of 1950?

Dr. ASTIN. 1952. I am sorry.

Senator FERGUSON. The first part of 1952?

Dr. ASTIN. Yes, sir.

Senator FERGUSON. And when did you start those tests?

Dr. ASTIN. They were started almost immediately.

Senator FERGUSON. You started on the controls of new batteries; is that right?

Dr. ASTIN. We ran——

Senator FERGUSON. Controls were new batteries?

Dr. ASTIN. We ran both new batteries and old batteries.

Senator FERGUSON. As controls?

Dr. ASTIN. No. We had controls in each. That is, there were two groups of tests, one on new batteries and one on old batteries, and in each group——

Senator FERGUSON. What were the controls? The new?

Dr. ASTIN. Both. If we want to evaluate the effect of the material on a new battery, then it is necessary that some cells in a new battery be treated and some remain untreated. The untreated cells would be called controls. And the same thing would be done in running a test on used batteries.

Senator FERGUSON. All right. Now, Doctor, did you have anything to do with the choosing of the batteries to be tested?

Dr. ASTIN. No, sir. That is left to the testers.

Senator FERGUSON. Do you know whether the tests were carried out in compliance with the instructions on the packages, as to how to use them?

Dr. ASTIN. I have complete confidence that the tests were——

Senator FERGUSON. No. I did not ask you that question.

Dr. ASTIN. Personally, I do not know.

Senator FERGUSON. You do not know?

Dr. ASTIN. No, sir.

Senator FERGUSON. Do you know whether or not the batteries were overcharged before the tests were started?

Dr. ASTIN. Not from any personal knowledge, I don't know.

Senator FERGUSON. Do you know from the records?

Dr. ASTIN. In some of the tests which were carried out, we gave to the batteries a preliminary charge before introducing the material in order to get information as to the quality of the cells before we treated them. This is necessary in order to have a valid base by which the comparisons between the treated and untreated batteries can be made.

Senator FERGUSON. All right. Now, did you read or hear Ritchie's testimony?

Dr. ASTIN. Yes, sir, I heard it yesterday morning.

Senator FERGUSON. You heard it?

Dr. ASTIN. Yes, sir.

Senator FERGUSON. Do you know that he says that you overcharged the batteries before you used the additive?

Dr. ASTIN. I do not give any particular weight to that——

Senator FERGUSON. No. That was not my question. My question was, Do you know it?

Dr. ASTIN. In some cases we charged the batteries before we tested them. We have made tests where——

Senator FERGUSON. No. Did you in this case charge these batteries—that is plural—before you used them?

Dr. ASTIN. I am not sure.

Senator FERGUSON. Can you find out from your records?

Dr. ASTIN. Yes, I can.

(Subsequently, Dr. Astin supplied the following information in letter of June 29, 1953, to the chairman:)

The instructions on the package read as follows:

"(1) Clean top of battery and battery posts." This was done.

"(2) Cover plates with water." This was done.

"(3) Empty one envelope to each cell." This was done except for some batteries 1 cell and for other batteries 2 cells were left untreated in order to serve as controls. This is in accordance with item 24 on form No. 90 issued by Pioneers, Inc.

"(4) Dissolve AD–X2 on top of plates with battery syringe." This was done.

"(5) Immediately start motor and charge for 30 minutes to blend AD–X2 with battery acid as sulfation preventive." This was not done per se since batteries were not tested in cars but batteries were charged for at least 30 minutes after AD–X2 was added. Instruction (6) is applicable in this case.

"(6) Fully charge at not more than 40 amperes when charger is used." This was done. For the Post Office test, the charging rate prior to the first discharge test was 5 amperes.

Senator FERGUSON. Now, do you claim scientifically that you cannot make the tests as indicated by the directions on his packages?

Dr. ASTIN. It can be made that way, yes.

Senator FERGUSON. It can be made?

Dr. ASTIN. Yes.

Senator FERGUSON. Why did you not follow the instructions that the customers or consumers were supposed to use?

Dr. ASTIN. I think in some instances we have.

Senator FERGUSON. Do you know whether or not you did in some instances?

Dr. ASTIN. In the tests that we ran last June, we followed his instructions in all essential details.

Senator FERGUSON. Now, when was the second request by the Post Office to make a test? In January of last year?

Dr. ASTIN. I don't have the date; I am sorry, sir. It is my recollection that it was the first part of 1952.

Senator FERGUSON. All right. Now, did you make tests under that for these——

Dr. ASTIN. Yes, sir.

Senator FERGUSON. Is that the so-called June test?

Dr. ASTIN. No, sir.

Senator FERGUSON. Now, where are the tests that you made for the Post Office?

Dr. ASTIN. Those are the tests we started early in 1951.

Senator FERGUSON. All right. Well, wait. You say that those early in 1951 were discarded because you did not use the material they obtained from the Post Office?

Dr. ASTIN. Early in 1952. I am sorry.

Senator FERGUSON. You started those early in 1952?

Dr. ASTIN. Yes, following the receipt of those——

Senator FERGUSON. With the actual packages furnished from the mail?

Dr. ASTIN. That is correct.

Senator FERGUSON. And did you follow the instructions on those packages?

Dr. ASTIN. It is—I will have to check for sure, but it is my recollection—and I said this in my general statement yesterday—that the major test to which we gave weight in both the Post Office and the Federal Trade tests, is a test given us by Dr. Merle Randall in 1948, which we called the Randall test, which he claimed was a very striking way to get results with this material.

Senator FERGUSON. All right. Now, what I am trying to get is, did you use the instructions, which, as I understand it, was the fraud—the instructions on the packages and the contents are what created the fraud upon the public that the Post Office authorities were trying to defend the public against——

Dr. ASTIN. Yes.

Senator FERGUSON. Did you use the instructions on the packages and the contents of the packages exactly?

Dr. ASTIN. I cannot answer that right now.

Senator FERGUSON. You cannot answer that. Will you furnish that for the committee?

Dr. ASTIN. I will.[1]

Senator FERGUSON. Now, the June tests were what tests——

Dr. ASTIN. Those were tests——

[1] See information on p. 283.

Senator FERGUSON. How did you come to make another test? Who asked you to make the June tests?

Dr. ASTIN. That was in my general statement yesterday. I gave the background on it in some detail. And I read a letter from Senator Nixon, who asked me if I could do something to attempt to resolve this matter completely.

The executive director of the Select Committee on Small Business of the House of Representatives also asked me if I would run an extra test. Mr. Ritchie had been asking me to, and I had hoped that by running an extra test using the procedure which he guaranteed would show the merits of his product we could settle this matter. And that is why this series of tests last June was run.

Senator FERGUSON. All right. Now, did you use the June tests before the Post Office Department?

Dr. ASTIN. Yes, sir; we did.

Senator FERGUSON. Did you use any other tests before the Post Office Department?

Dr. ASTIN. It is my recollection that we used only the tests for the Post Office Department and the June 1952, tests.

Senator FERGUSON. All right. Then you did not use, in compliance with the law, the matters that went through the mail, is that a fact, to get the fraud order?

Dr. ASTIN. On this, we attempt to give a technical opinion to the Post Office Department. Now, the legal interpretation of this in connection with fraud is not our business.

Senator FERGUSON. But Dr. Astin, you told us that the post office authorities turned down your first tests because they were not legally conducted in order that they might use them?

Dr. ASTIN. That is right.

Senator FERGUSON. Now you tell us that you made tests for them in compliance with their request as to legality and all, and you did not use those, but you made further tests of your own in June?

Dr. ASTIN. That is right.

Senator FERGUSON. And you used those; is that correct?

Dr. ASTIN. That is correct.

Senator FERGUSON. Then we find that the fraud order was not issued in compliance with the legal requirements, according to your statements here this morning.

Dr. ASTIN. The legality of that, you will again have to check with the representatives from the post office. This much I think is true about that. The hearings the Post Office Department planned to run on this matter were postponed until these June tests came out at the request of representatives of this committee. That is my understanding.

Senator SPARKMAN. May I interject right there, because I have been checking some dates on that, Dr. Astin?

The CHAIRMAN. You may.

Senator SPARKMAN. I think it would be quite relevant.

Apparently these letters started coming to the Senators about February. The letter that I received originally was February 19, 1952. That letter was referred to the committee staff. Copies of that letter have been sent also to other members of the committee.

On February 25, Mr. William Amis of our staff telephoned Dr. Astin to request whatever information was available on the battery

additive AD–X2. The next day, Dr. Astin wrote Mr. Laurance G. Henderson, staff director, and sent up Bureau Circular 504 on battery additives, a Bureau memorandum on battery additives dated August 28, 1951, and a copy of a letter of January 21, 1952, addressed to Mr. Ritchie.

Now, apparently there was no other activity between our committee and the Bureau of Standards until July 1, 1952, when Blake O'Connor wrote over the signature of Mr. Henderson, the staff director, to Dr. Astin, requesting background information and current data relating to tests made by the Bureau of Standards on AD–X2. This letter was written as a result of a call made by Mr. Ritchie at the offices of the committee, during which he stated that he did not feel that the Bureau of Standards had fairly tested his product.

Now, the request to the Post Office Department to postpone the hearings was not made until July 30, 1952.

Dr. ASTIN. All right. Then I just have my dates wrong.

Senator SPARKMAN. Yes.

Dr. ASTIN. I am sorry.

Senator SPARKMAN. I thought it was well to get these dates in.

Dr. ASTIN. I am glad you did it, sir.

Senator SPARKMAN. The Post Office Department had scheduled a hearing originally for August 11.

Dr. ASTIN. I see.

Senator SPARKMAN. And on July 30, Mr. Blake O'Connor wrote a letter to the Post Office Department requesting a postponement until more conclusive scientific information could be gathered on the subject.

So, I believe those are the relevant dates. Later Mr. O'Connor asked the Post Office Department if it would postpone the fraud hearing until the MIT tests were completed. Apparently those were the only two requests ever made of the Post Office Department.

Dr. ASTIN. I see.

The CHAIRMAN. Senator Ferguson.

Senator FERGUSON. Now, Doctor, do you want to change any answers that you gave me?

Dr. ASTIN. I cannot recall any right now, sir. I have answered your questions to the best of my ability and recollection.

Senator FERGUSON. I am wondering whether or not——

Dr. ASTIN. Well, I thought I had corrected this one thing.

Senator FERGUSON. I thought I had asked you whether or not you wanted to change any answers.

Dr. ASTIN. There had been a deferment in the date of the Post Office hearings, and the Post Office people, according to my understanding of the situation, felt that because the thing had been deferred so that they could consider the data from these June tests, they would include it. Now, as you have realized, I am not sure, or was not sure, as to who asked the Post Office to postpone the hearing.

Senator FERGUSON. But, Doctor, come back to this question: Was the fraud order issued on the June tests?

Dr. ASTIN. This you would have to have the Post Office Department answer. In the hearing we had before them last October, we gave them data from the June 1952 tests; yes.

Senator FERGUSON. You said you had not given them any other?

Dr. ASTIN. No. We gave them that data and then we gave them the data on the tests we conducted on the samples they supplied us early in 1952.

Senator FERGUSON. Now, in those tests did you deviate from the instructions on the packages that the consumer was supposed to use?

Dr. ASTIN. As I mentioned before, I will have to check that and give you the information. I am not familiar with that specific point.

Senator FERGUSON. Have you a transcript of your testimony before the board, the post office authorities? [1]

Dr. ASTIN. No. I have never seen that.

Senator FERGUSON. Were you sworn in that testimony?

Dr. ASTIN. That is my recollection; yes, sir.

Senator FERGUSON. Do you know what held up the order until February of 1953 by the post office authorities?

Dr. ASTIN. No, sir; I don't know that.

Senator FERGUSON. Were you consulted further?

Dr. ASTIN. No, sir.

Senator FERGUSON. Going back to one other item about a letter dated March 7, 1950, to K. B. Willson, National Better Business Bureau, Inc., Chrysler Building, New York, from Mr. Vinal—he was your chief, Electrochemistry Section——

Dr. ASTIN. Yes.

Senator FERGUSON (reading):

> In response to your telegram of March 3 which I did not receive until March 6, and my reply of the latter date, I am sending herewith rough draft of the proposed circular on battery additives. I had hoped to have it in somewhat better shape before sending it to you. I shall be glad to have your comments and criticisms of both the scientific information and its legal aspects as you have learned from past experience.

Now, why was your department writing to a better business bureau asking for both scientific information, their criticisms on it, and their comments on its legal aspects?

Dr. ASTIN. The first part of that request is a perfectly natural one, and is representative of the type of thing we do all the time in attempting to appraise general interest in information which we propose to establish. That is, we attempt to get consensuses of opinion from people who are interested in the data. The second part of the request is unusual, and——

Senator FERGUSON. Had you ever heard of it before in your department?

Dr. ASTIN. Well, one is always concerned, of course, with complying with the law. If one was running any risk of it in this case, as Dr. Vinal appeared to believe he might—otherwise he would not have raised the question—one gets expert opinion.

Senator FERGUSON. You had your own legal department.

Dr. ASTIN. That may have also been consulted.

Senator FERGUSON. You had your own legal department; you had the Attorney General's Office, who is an adviser to your department; is that not a fact?

Dr. ASTIN. That is a fact.

Senator FERGUSON. And you had your own scientists. Now, would you tell us why you were writing to a better business bureau to get

[1] See pp. 296–301 for Dr. Astin's testimony before Post Office Department, October 14, 1952.

scientific information and legal information when you had your own scientists and had the Attorney General and your own legal department?

Dr. ASTIN. The request for legal advice was perhaps inappropriate, and my——

Senator FERGUSON. What did the better business bureau know about the scientific information?

Dr. ASTIN. Our basic legislation, Mr. Senator, says that we may publish the results of our scientific and technical findings when such information is of importance to scientific or manufacturing interests. Therefore, I think it is necessary in compliance with that requirement in our basic law to make some effort to determine such interest before publication.

This I think was a very clear example of complying with that provision of the law.

Senator FERGUSON. Doctor, did you know that the Better Business Bureau of Oakland, Calif., where this man lives, had never made a complaint and in fact had seen, as his testimony showed yesterday, what he was sending out, and all, and they had no complaint, and the same thing was true in San Francisco, across the bay?

Dr. ASTIN. I believe that was known at that time.

Senator FERGUSON. That was known. And notwithstanding——

Senator SMATHERS. Mr. Chairman, may I interrupt to get one thing straight which would help me in understanding the Senator's questions better, and these answers?

A minute ago, the Senator asked the doctor when he came into the chain of command. And I think the doctor testified that it was not until about 1951.

Now, these letters are written not by this doctor, but by another doctor, and in 1950, and it may well be—and I do not know, and I wish the Senator would ask Dr. Astin this—did he have personal knowledge that that particular letter was written?

Senator FERGUSON. This is not a matter of this particular witness——

Senator SMATHERS. But you are asking questions of this witness.

Senator FERGUSON. He just happens to be on the stand. I am trying to find out what the department did.

Senator SMATHERS. I think that, in view of your first question as to where he was in the chain of command, when he stated that he did not get into the chain of command until 1951——

Senator SPARKMAN. What date in 1951?

Dr. ASTIN. I was named Acting Director of the Bureau about October 8, I believe, 1951.

Senator SMATHERS. And this letter was written in March 1950?

Senator FERGUSON. Yes. I am not——

Senator SMATHERS. I know. But the implication is that he knew all about this and that he was responsible for it, when the fact of the matter is that he probably had no personal knowledge of it.

Senator FERGUSON. All right. I am not concerned with personalities. What I am concerned with here is what the department did. I want to know why this became such a celebrated case back in 1950 that you were writing to a better business bureau to get advice on scientific matters and on legal matters.

Senator SMATHERS. Now, if the Senator is interested in personalities, why don't you ask why the department wrote it, but not this man?

Senator FERGUSON. This record is pretty clear. We have no misunderstanding in this record.

Doctor, what was your command prior to 1951?

Dr. ASTIN. I was Associate Director of the Bureau from about the first of 1951 until October, at which time I was named Acting Director.

Senator FERGUSON. What was it prior to the first of 1951?

Dr. ASTIN. I was Chief of the Electronics and Ordnance Division.

Senator FERGUSON. Did that have anything to do with batteries?

Dr. ASTIN. Not this kind.

Senator FERGUSON. Not this kind of batteries?

Dr. ASTIN. That is right.

Senator FERGUSON. Did it have anything to do with making tests?

Dr. ASTIN. Not battery tests of this sort.

Senator FERGUSON. Doctor, when did you first hear of AD–X2?

Dr. ASTIN. I am not sure that I can recall the exact date, but I know I heard about it during the summer of 1951. Whether I heard about it before or not, I am just not sure.

Senator FERGUSON. Had you, prior to that time, ever known anything about it being in the department?

Dr. ASTIN. I have no recollection of any specific information about it before that time. I knew that the Bureau had tested battery additives.

Senator FERGUSON Where is Dr. Vinal now?

Dr. ASTIN. He is living in Princeton, N. J.

Senator FERGUSON. And what is his business?

Dr. ASTIN. He is retired.

Senator FERGUSON. Had he ever been connected with any battery manufacturers?

Dr. ASTIN. He is now doing a little consulting work for the Electric Storage Battery Co. in Philadelphia.

Senator FERGUSON. Is this the gentleman you were talking with Senator Hunt about when I came in—that you thought it was very unfair to make any inference? Is that the gentleman?

Dr. ASTIN. That is the gentleman; that is right.

Senator FERGUSON. And he is the gentleman who was asking for this scientific information and legal information from a better business bureau while he was with the department?

Dr. ASTIN. Well——

Senator FERGUSON. What did he have to say about that?

Dr. ASTIN. The request for the opinion of the scientific information as a representation of general usefulness is a perfectly logical thing to do, and I think is fully justified by our basic legislation. Now, the request for legal advice is out of order, and I would guess it was just thrown in, as he was writing to him for advice on one score, and he coupled this as well.

Senator FERGUSON. Doctor, in another letter—you say "thrown in"—in another letter he was asking, on March 7, 1950, for legal opinion and legal criticisms. You would not say that it was just thrown in or got in by mistake, would you?

Dr. ASTIN. No; I would not say it got thrown in. I would guess that his primary interest was in the technical contest of the report and its general usefulness or interest. If he had concern over any

possible legal aspect of the thing, I believe it would have been better to get advice from Government counsel. But I cannot answer why that was done.

Senator FERGUSON. Doctor, do you know Mr. Willson?

Dr. ASTIN. Mr. Willson of the National Better Business Bureau?

Senator FERGUSON. Yes.

Dr. ASTIN. I have talked to him one or two times on the telephone, and had letters from him. I have no recollection of having met him.

Senator FERGUSON. In connection with this?

Dr. ASTIN. No.

Senator FERGUSON. Have you communicated with him on the telephone and by letters?

Dr. ASTIN. He has called me on the telephone in connection with this.

Senator FERGUSON. Is he a scientist or a promoter?

Dr. ASTIN. I don't know Mr. Willson's background.

Senator FERGUSON. Do you not think it is material here to know whether or not he had any scientific information? Would you expect to get scientific information from a better business bureau?

Dr. ASTIN. I would say that a better business bureau is in a position to appraise the interest of business in a particular class of information, and it is on that basis that we requested the advice of the National Better Business Bureau.

The CHAIRMAN. Doctor, your Division is really a part of the Commerce Department; is it not?

Dr. ASTIN. That is correct.

The CHAIRMAN. Therefore, the Commerce Department has responsibility to the business world of this Nation?

Dr. ASTIN. That is correct.

The CHAIRMAN. Therefore, if it was a question on a legal basis, it should have gone to the Department Solicitor or to the Attorney General's office; if it was a question relating to business policies, other divisions of the Commerce Department would have been likewise the proper agency that you might have submitted your report to for an opinion, whereas you submitted it to the better business bureau, which is not a part of the Government nor to which you have any legal responsibility.

So if your letter had been directed to the Secretary of Commerce, it would have been perfectly understandable, but your letter was directed to the National Better Business Bureau, an organization which has no responsibility over your Department.

Dr. ASTIN. That is correct.

The CHAIRMAN. There lies the irregularity that we are concerned with.

Dr. ASTIN. I will admit that the question of legality is an irregularity. However, the other question, for general comment on the circular, is, in my opinion, completely in line with complying with the legal requirements of our act in connection with the presentation to the public of scientific findings.

The CHAIRMAN. Yes. But if I may pursue it just a little bit further, Doctor, if you were in doubt about the phraseology of a report, then it would seem to me that it would have been perfectly proper had you gone to the Commerce Department, which is charged with the

responsibility, not only over the Bureau of Standards but with the business economy of this Nation.

Dr. ASTIN. That is right.

The CHAIRMAN. And the Attorney General will interpret any legal question?

Dr. ASTIN. Yes.

The CHAIRMAN. Therefore, it seemed a little irregular that you should be responsive to the better business bureau in trying to perfect the language of the report that you were preparing to submit. It would have been more proper, in my opinion, had you disregarded the pressure of the better business bureau and gone to your own agency, the Commerce Department, to determine what type of language should go out in the report.

Dr. ASTIN. This may have been done. In general, the overall guidance as to publication policy is provided to the Bureau by the Secretary of Commerce, and it may have been in this instance; but I don't know.

The CHAIRMAN. We find no record of any communication from the Bureau of Standards to the Commerce Department.

Dr. ASTIN. This is the sort of thing that if it were done at all probably would have been done verbally.

The CHAIRMAN. And you do not recall that you have ever had a verbal conversation with the Secretary of Commerce on this question before the bulletin was issued?

Dr. ASTIN. There may have been, but I am not sure.

The CHAIRMAN. Senator Ferguson.

Senator FERGUSON. Doctor, going back—I realize it is getting late, and we will probably have to recess until 2 o'clock—and I can see why you should give the benefit of the doubt on any criticism of Dr. Vinal and his relationship with the better business bureau. Now, this is not discounting the place in the business world of the better business bureau. They have rendered great services in their various communities. There is not any doubt about it. But I am wondering, when you get sentences like this—and you have heard of circumstantial evidence even in the field of research, have you not?

Dr. ASTIN. Yes.

Senator FERGUSON. On December 9, 1948, George W. Vinal writes to K. B. Willson, National Better Business Bureau, Inc., and he says in the last paragraph:

> At a recent meeting of the Association of American Battery Manufacturers in Chicago I discussed this revision with several present and left a copy with Mr. L. E. Wells for his comments.

Now, they were referring to this:

> Reference is made to our previous correspondence on the subject of battery "dopes" and a revision of Letter Circular No. 302.

Now, why would he be writing to the better business bureau that he had been conferring with the American Association of Battery Manufacturers in relation to this additive?

Dr. ASTIN. This was not in relation to this additive. This was with respect to Circular 504, in which data on AD–X2 was incidental.

Senator FERGUSON. Surely; exactly. No. It was not incidental. Wasn't the sole purpose of the last order—what is the number of it?

Dr. ASTIN. Circular 504.

Senator FERGUSON. Circular 504. Wasn't the sole purpose of it to have it antedate the tests or your experience with additive AD–X2?

Dr. ASTIN. Oh, no.

Senator FERGUSON. Why not? Is that not the way these letters all read? Here was the better business bureau that had your Circular 302 condemning everything, and now you come along and they want to change; the better business bureau wants to get a quote from you. They want to get a test, a report, from you, and at the same time that we are working with you to get 302 changed, your man in your department is over conferring with the Association of Battery Manufacturers, who, by the way, many of them, say that if you use any additive, they withdraw all guaranties. How do you account for it? What is a reasonable inference from this?

Dr. ASTIN. This Circular 504 dealt with general information about the effect of sodium and magnesium sulfates on the performance of lead-acid batteries. To obtain such data, it was necessary to have techniques and procedures for evaluating battery performance. There were technical questions involved in this. Among the people best qualified to comment and appraise methods of evaluating battery performance are the technical engineers and scientists in the battery industry. It is only by our working with such people and talking with them that we can develop improved methods of evaluating battery performance.

So, discussing the technical content of a circular about batteries and battery performance with people from the battery industry is a perfectly logical thing to do, and I would say that if we failed to do something like that, we would be negligent in getting the best possible advice on the technical presentation of our information.

Senator FERGUSON. All right. Now, Doctor, on the same philosophy, why don't you go to the users as well as the manufacturers?

Dr. ASTIN. The scientists and engineers are in the manufacturing organization. They are the people we want to see, Senator.

Senator FERGUSON. I know. But the man who pays the bill is the user. And, as I understand, the chairman has indicated, there are large fleets using this product from year to year and finding it beneficial and paying for it in reorders. Why didn't you go and consult them as well as the manufacturers?

Dr. ASTIN. Because that would have involved market analysis work, and that is not our business. Our business is in science and technology, and the scientists and engineers who are experienced in battery performance work are found primarily in industry, some in the universities, and if we want information, if we want to improve our battery competence, then we have to work with the technical people in the battery industry. We don't find such people in general in the consumer field.

Senator FERGUSON. Wasn't Willson trying to get you to get a revision out of 302 before you made tests on AD–X2?

Dr. ASTIN. Yes, that is correct. It is my recollection——

Senator FERGUSON. And, therefore, he had conferred with the battery manufacturers? So they were going to condemn this product without even a test?

Dr. ASTIN. No, sir; that is not true.

Senator FERGUSON. What is true?

Dr. ASTIN. I think the correspondence on this will show that, as I recall it, in one of those early letters, Dr. Vinal told Mr. Willson that he had been contemplating a revision of 302 for some time, and this contemplated revision, I believe, was before Dr. Vinal ever heard of AD–X2.

Senator FERGUSON. But, Doctor——

Dr. ASTIN. Now, the reason for that, if you will let me finish just a minute, Senator——

Senator FERGUSON. Yes, I will.

Dr. ASTIN. And I will repeat something I told Senator Smathers earlier. The Bureau had tested some 2 dozen battery additives since this earlier Circular 302 was issued. In 1947, there were five battery additives tested for various other Government departments. In 1948, there were two other additives tested, and in addition, a wide variety of chemical compositions was examined for the Bureau of Aeronautics.

Now, here was a mass of new technical data. True, it merely confirmed prior conclusions, but it was recent, up-to-date investigation. It was information obtained at the public expense. The public is entitled to this recent information. So, it is quite logical that Dr. Vinal, in view of all this recent activity in this area, would have been thinking about a new publication.

Senator FERGUSON. Doctor, do all the batteries use the same way of making them work?

Dr. ASTIN. Oh, no. There are wide varieties of batteries.

Senator FERGUSON. All right. Is there any battery made that you add anything to other than distilled water?

Dr. ASTIN. I don't know that any battery works with just distilled water. As I explained——

Senator FERGUSON. Why do you call these things additives? Does the manufacturer say to use distilled water?

Dr. ASTIN. The manufacturers, according to my recollection of their instructions, say, for lead-acid storage batteries, to add only distilled water to the electrolyte.

Senator FERGUSON. All right. Now, do I understand that scientifically any other product known, if added, is destructive, or does not do anything more or better than distilled water?

Dr. ASTIN. In a lead-acid-type storage battery, I know of no information on any material which improves the performance of a plain sulfuric-acid solution.

Senator FERGUSON. All right. Then you have reached the zenith, when there is only one thing to add, and that is water, as far as making a battery work?

Dr. ASTIN. Well, that——

Senator FERGUSON. You think they are through now?

Dr. ASTIN. No, no; they are by no means through.

Senator FERGUSON. How do you know, then, that this fellow hasn't got a new thing?

Dr. ASTIN. Because we have tried extensively to find some merit to the product, and cannot. If it had an effect on battery performance, we would be able to measure that effect, sir.

Senator FERGUSON. Now, I want to go back to a letter of June 25, 1948, a letter from Dr. Vinal to Mr. Willson, again:

This is in reply to your letter of June 10, 1948, regarding battery compounds which seem to be becoming increasingly numerous and troublesome.

Dr. ASTIN. Yes.

Senator FERGUSON (continuing):

I see no reason at the present time to change the statements made in our Letter Circular 302.

You were going to tell us that Vinal was going to change it, and he was the one who was instigating the change. Here is what he said:

I see no reason at the present time to change the statements made in our Letter Circular 302, but realize that the date of this circular is rather far back. The later statement by Dr. Briggs, which you have quoted, is, I think, a very good statement, and I see no reason why you should not continue to use it.

Aside from a few tests made recently, the only other work we have done on this subject was in connection with a search for satisfactory methods of storing surplus batteries following the close of the war.

And his last paragraph:

I have had it in mind for some time that we should issue a new letter circular to supersede the present 302, and in the new circular incorporate some of the data more recently obtained. Unfortunately, the press of other matters has prevented me from doing this. I shall be glad to have your opinion as to the desirability of issuing an up-to-date statement of the problem.

Doctor, you have analyzed all the correspondence?

Dr. ASTIN. I have been through most of it; yes, sir.

Senator FERGUSON. Well, now, haven't you been through all of it? I understood the Chair to ask you to go over all of it.

Dr. ASTIN. Yes. I have been through the correspondence with the National Better Business Bureau.

Senator FERGUSON. And will you now state that in your opinion everything is regular in compliance with the orders and instructions of the department as far as this correspondence is concerned?

Dr. ASTIN. I think aside from the reference to seeking for legal advice, that everything is in order in that correspondence.

Senator FERGUSON. Everything except the one seeking legal advice?

Dr. ASTIN. That is correct.

Senator FERGUSON. Have you any opinion as to why they were seeking legal advice?

Dr. ASTIN. Well——

Senator FERGUSON. Was the better business bureau fearful that they might get into a legal suit and be subject to damages unless they could get the approval of your department to something?

Dr. ASTIN. It may be——

Senator FERGUSON. Is that not clear on its face?

Dr. ASTIN. It undoubtedly was associated with something of that sort.

Senator FERGUSON. And is it not apparent that Vinal was perfectly willing to even seek the advice of the better business bureau?

Dr. ASTIN. Oh, he did seek it, according to the letters.

Senator FERGUSON. He did seek the legal advice?

Dr. ASTIN. Yes.

Senator FERGUSON. Now, do you say that this request here for scientific information was regular, from a better business bureau?

Dr. ASTIN. Yes, sir. No. The request was not for scientific information.

Senator FERGUSON. Well, what was it?

Dr. ASTIN. It was a request to appraise the general value of the report, its mode of presentation, and so on.

Senator FERGUSON. Do you think that the better business bureau was in a position to comment and criticize your scientific information?

Dr. ASTIN. The battery people could criticize the scientific information. The better business bureau could criticize its general usefulness.

Senator FERGUSON. Now, do you claim that the better business bureau was a representative of the battery people and, therefore, they were writing to the better business bureau to get the battery people's criticism?

Dr. ASTIN. No. I am not saying that the better business bureau represented the battery people.

Senator FERGUSON. What did your last answer amount to?

Dr. ASTIN. I say that the National Better Business Bureau, as far as I understand its operation, does represent business and manufacturing groups in this country. And since our latest regulation calls for determining the interest of scientific and manufacturing groups in our data prior to publication I think that an opinion on this score as to the interest of the National Better Business Bureau in the matter is a very logical thing to do.

Senator FERGUSON. All right. Then it is your conclusion that Dr. Vinal had a right to believe that Mr. Willson was representing the battery manufacturers, and when they sent this letter, this information, it would go on to the battery manufacturers and be criticized by them or commented on by them, and brought back to you?

Dr. ASTIN. No, that is not—I did not say that I thought that they represented the battery groups but that they represented a much broader group of business people. His request to the National Better Business Bureau would include a consensus on a much broader base than just the battery people. And he did consult the battery people directly——

Senator FERGUSON. Would it include the consumers? Would it include Ritchie, who was manufacturing one of the products? Why didn't you send it to him to have him criticize it?

Dr. ASTIN. We had already had Mr. Ritchie's opinions on this matter.

Senator FERGUSON. You mean, back in 1950?

Dr. ASTIN. Well, he had written us, or Dr. Randall, his consultant, had written us their opinions of Circular 302.

Senator FERGUSON. Doctor, do you feel that the better business bureau represented just a particular group, or all the manufacturers? Don't they represent all of the people, in fact?

Dr. ASTIN. It is my understanding that the National Better Business Bureau represents as broad a consensus of business interests as you can find in this country.

Senator FERGUSON. And consumers?

Dr. ASTIN. I think also they are interested in consumers. But their interest is primarily in the business organizations and their relation to consumers.

The CHAIRMAN. Doctor, is not the whole purpose of that better business bureau to safeguard the purchasing public or the consuming public?

Dr. ASTIN. I think that that is one of their functions; yes.

The CHAIRMAN. At least, I always took them to be that type of agency. They would be absolutely useless to the consumer if they just concerned themselves with the manufacturer.

Dr. ASTIN. I know that the ordinary consumer looks on the National Better Business Bureau for guidance and help and assistance.

The CHAIRMAN. It is now 12:30. We will stand in recess until 2 o'clock.

Thank you, Doctor. I am afraid we will have to resume after lunch.

Dr. ASTIN. Thank you.

(Whereupon, at 12:30 p. m., a recess was taken until 2 p. m., the same day.)

(Following is a portion of the transcript of proceedings before a hearing examiner for the Post Office Department, October 14, 1952, in Washington, D. C., in the matter of Pioneers, Inc., Jess M. Ritchie, W. M. Hager, Valera Ritchie, and Jess M. Ritchie, president, at Oakland, Calif., H. E. Docket No. 1/260 (referred to on pp. 280 and 287).)

Mr. O'BRIEN.[1] I call Dr. Astin.

HEARING EXAMINER. Will you raise your right hand, Doctor. Do you swear the testimony you are about to give in this case will be the truth, the whole truth, and nothing but the truth so help you God?

The WITNESS. I do.

Whereupon, Dr. Allen V. Astin, called as a witness for and in behalf of the Solicitor and having been previously duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

By Mr. O'BRIEN:

Q. State your full name, please sir?—A. Allen V. Astin.

Q. And what is your position?—A. Director of National Bureau of Standards.

Q. And how long have you been a Director of the Bureau, Doctor?—A. Since last June.

Q. Were you previously connected with the Bureau?—A. I have been a member of the staff of the Bureau since 1932.

Q. Would you give us just a very brief statement of your professional background—I mean your educational background, degree, and so on?—A. Postgraduated from the University of Utah, and majored in physics in 1925. Attended New York University from 1925 to 1928 and was awarded master and doctors degrees in physics. That was followed by 2 years at the Johns Hopkins University as a national research counsel fellow in physics, and that was followed by 2 years as a research associate at the National Bureau of Standards for the Utilities and Research Commission of Illinois, and that brings us up to 1932, at which time I joined the staff of the National Bureau of Standards as a physicist in the Heat and Power Division. There I was engaged in work on spark-plug development and testing, and on ignition system shielding problems. In 1936 I transferred to the Bureau of the Electricity Division, where I was engaged in the work on electronic instrumentation problems, precise electrical measurements, measurements on insulating material, and so on. In 1940 I was assigned to an ordnance group set up at the National Bureau of Standards and was connected with the Ordnance Board continuously from then until 1950, at which time I was named an Associate Director of the Bureau and assumed broader responsibilities, and October 1951, I was named Acting Director of the organization which post I held until I was sworn in, in June.

Q. Doctor, in the course of your duties, as Director of the National Bureau of Standards, have you had occasion to study the utility or the usefulness of various additives for automobile batteries or lead-acid storage batteries?—A. Yes, I have. I have been involved in that work more closely and directly, I think, than I normally get associated with projects in the various technical divisions of the Bureau. I first got interested in this field about—during the summer of 1951 and have studied and followed the whole problem rather closely since that time.

[1] W. C. O'Brien, Office of the Solicitor, Post Office Department, Washington, D. C.

Q. The procedures, Doctor, which are used by the Bureau in studying problems of that kind, are they improvised or are they a result of scientific theory or what—from what—how are they—how are they brought about, how are they arrived at?—A. I am not quite sure that I understand what you mean?

Q. In other words, assuming you have a problem with respect to the efficacy of something which is supposed to help a storage battery. I assume the Bureau followed certain procedures to make a determination of that question.—A. Well, there are well-defined procedures for determining the merits of a storage battery. The major characteristics which are important are its ability to deliver electrical energy in its line, and those two characteristics can be measured quite easily in well-defined tests.

Q. Are they generally accepted measures, Doctor? I mean the engineering or the storage-battery field in general acceptance.—A. One of the engineering groups, and I am not sure which it is, I believe it is the Society of Automotive Engineers, has a standard test procedure for rating automobile storage batteries.

Q. Well, what I am trying to find out, is the standing of the Bureau's procedures in the general field of testing, whether it is generally accepted or whether it is generally rejected, or whether it is singular and only stands by itself as a Bureau-accepted procedure?—A. Well, we are charged by the Congress with responsibility for developing testing procedures for materials, mechanisms, and structures and with carrying out tests on such things. In addition we are charged with cooperating with other Government agencies and private organizations in developing standard specifications, codes, and testing procedures. This type of activity has taken a great deal of the attention of the Bureau for many years and I think that we have an enviable reputation as an authority in the development of reliable testing procedures for most any material, mechanical device, or appliance.

Q. Would that also apply to chemical things like this Pioneer's preparation AD–X2?—A. Yes, materials like that would be included—have been included in that overall statement of functions, yes.

Q. Well, Doctor, you are familiar with the fact that the Bureau has recently made several tests, of course, on various—for various Government agencies and on AD–X2, are you not?—A. Yes, I am.

Q. And were those tests made under your supervision or with your approval?—A. They were made with my approval and under my general, but not immediate supervision.

Q. Now, in the case of the so-called suicide test of battery AD–X2, can you tell us whether that was done in agreement with or upon a prescription set up by Mr. Ritchie of Pioneers, Inc?—A. Yes, it followed in, I think, all essential details a testing procedure which he had given to us at my request. He had criticized prior tests of the Bureau on battery additives and—or because they—he said they were not designed to show the merit of his product and so I asked him to prescribe a testing procedure which would show the merits of his product and this so-called suicide test was his answer to my request.

Q. Now, does the criticism which he directed at previous tests of the product, did you consider that sound, Doctor?—A. I did not consider them particularly sound: no, sir. I asked him to do it primarily in an effort to satisfy some of his proponents, and I had no doubt as to the validity of the other test, but I was willing because of the great interest in this matter and the great following which this product appears to have to carry out some additional tests in the hope of resolving the matter.

Q. So that the previous tests, some of which were made for this—at the request of the Post Office Department, were in your opinion valid and reliable tests and their results may be taken for—as accurate by this Department?—A. Yes, sir; they were.

Q. Now, did you participate personally in any phase of the so-called suicide test?—A. Yes, I reviewed the detailed testing procedure before it was started and I actually, with advice from our statistical experts, selected the batteries to be treated and those which were not to be treaetd. I supervised with the assistance of a young man from one of the other divisions, who had not been connected in any way before or since with this test, the insertion of the additive in the batteries selected to be treated, wrote down the code to the batteries which were treated and kept that code in the safe in my office until the test was completed.

Q. Then nobody knew which batteries had been——A. No, nobody knew during the course of the test which batteries had been treated and which had not been treated except myself.

Q. Well, in using the expression which batteries had been treated, Doctor, just exactly what do you mean by "treated"?—A. They were given an application or

dose of material AD–X2 in accordance with instructions provided by the manufacturer.

Q. And what—did the manufacturer provide the AD–X2?—A. He provided it, but it is my recollection that we purchased it from him, but he delivered it personally, in order to——

Q. Well, I mean it was actually—no doubt of it being AD–X2?—A. Oh, no; he turned it over to us directly. There is no doubt about that, that is correct.

Q. Have you—are you familiar, Doctor, with the report which was subsequently prepared on the basis of those tests—A. Yes, sir; I am.

Q. That suicide test, and will you tell the hearing examiner whether—how you regard that report as for reliability and accuracy.—A. Oh, I have complete confidence in the basic reliability of the report and the conclusions which are drawn from it and the data which are presented in it——

Q. Doctor—Doctor——A. There are a few minor errors, typographical or transposition errors, in the first draft of it, but none of them were of any consequence, and I think most of those have since been corrected.

Q. You were present, in fact, it was in your office or conference room that Mr. Ritchie and certain members of your staff, Dr. Hamer and Dr. Craig, and some others, I can't just recall the names, and Mr. Grant, of Justice, and Mr. O'Connor, of the Small Business Committee of the Senate, myself, and Doctor—I think he is—Dr. Laidler, of Catholic University; and Weber, of Massachusetts Institute of Technology, met, I think, about 10 days or so ago; you were there——A. Two weeks ago today.

Q. At that time, sir?—A. Two weeks ago yesterday.

Q. Two weeks ago. And you listened to the, in fact, the criticisms of the test were addressed to you by Dr. Weber, and in his discussion did he advance anything at that time that you would doubt as to the reliability of these tests, this suicide test?—A. No; in my opinion he didn't raise a single important criticism to the report. He critized the number of minor phases of it, but he did not advance any sound argument going to the validity of the conclusions on the two major items under test.

Q. At that time, Mr. ——, you recall, do you recall that Mr. Ritchie voiced his dissatisfaction with the test and declared it was an unreliable one, you recall that?—A. Yes.

Q. And, in order that we may have a record, would you tell the hearing examiner whether in the conduct of that test any—there was any slanting or bias or attitude toward the test other than the effort to determine scientifically the use of—usefulness of AD–X2?—A. No; there was no bias whatsoever in the planning or carrying out of that test. We were interested in determining the facts. If the test result showed the material to have merit that would have made no difference to us. Now, the criticisms which Mr. Ritchie leveled at the turning out of the test involved the values of the density of the electrolyte in the batteries. That had not been specified in advance or in setting up the test procedure initially, other than we told Mr. Ritchie to tell us what material to put that—what density of acid to put in the batteries to start out and that was done in accordance with his initial instruction. However, after he had examined these batteries initially, that was also a condition of the test that he would examine them and determine that they were siutable batteries to show the merit of his product. After he had done that we let him have some of the rejects on which he had some tests run and he determined from these that the gravity readings were going to be higher than he expected. Then he came around with a proposal that if the gravity reading reached a certain value, then we would pull some of the electrolyte out and insert distilled water in place of the electrolyte removed. This, in my opinion, would have created a difference in the testing procedure for the treated and untreated batteries, since it was now well known that the gravity reading for the treated batteries would be slightly higher. And it was my desire to keep the—all of the exposure and treatment conditions to the two groups of batteries identical throughout the test. So I rejected this proposal after extensive consultation with our own battery experts that the higher gravity readings would do no harm and, in fact, are used in many types of batteries, particularly some sorts of heavy-duty batteries, as these apparently were.

Q. Now, Doctor, referring again to the conference in your office, Dr. Weber, of MIT, related his experiences with the dividing up of a battery cell, I think, in treating charging and discharging, one half of which was treated and the other half of which was untreated, do you recall his recitation?—A. Yes; I do.

Q. Was there anything in his report, assuming that it is correct, assuming that what he told us was correct, is there anything in that report which would reflect adversely or show any weakness or cast any doubt upon the suicide test and these other tests made by the Bureau?—A. No; I don't see how it would, because the tests, as we ran them, were designed to show a difference in capacity of the batteries. That being a major measure of quality of the battery. No difference was shown; and even if this fact that Dr. Weber demonstrated, or claimed to have demonstrated, is true, it would not have any bearing on the conclusions already drawn. This particular bit of evidence he introduced, which was such a small sample as to be statistically insignificant, is the first bit of information we have encountered that there might be any difference at all, any significant difference at all, in the behavior of a treated and untreated battery. But even if this difference is real, it does not, in my opinion, establish the superiority or any particular merit for the battery additive. If his—I will put it this way, if his experiment can be verified or duplicated, we will want to find out what its significance might be. It might conceivably have some trivial or secondary effect, but all of our prior results are completely valid with respect to the effect of the treatment on the main performance characteristics of a battery. If you recall, all of his particular tests show that if one took a battery and gave it a very weak charge for a very short time with a very dilute acid there was a difference in charging rate and none of these particular conditions are the types of conditions one encounters in practical use of storage batteries. It is a test which he claims showed a difference between some performance characteristics of the two types of batteries. There is considerable doubt as to whether the effect is real; but even if the effect is real, it by no means demonstrates any superiority of the product.

Q. There was some discussion, Doctor, as to having further tests made along that line, either at the Bureau or———A. Yes; we would like to see if we can repeat the observations he recorded and are so planning to do.

HEARING EXAMINER. And that is Dr. Weber?

The WITNESS. Harold Weber, of the Massachusetts Institute of Technology; that is right.

By Mr. O'BRIEN:

Q. But assuming that the same results are duplicated, that would not, as you understand, discredit the report on the suicide test?—A. No.

Q. Now, would———A. It might conceivably indicate there is a little difference in charging characteristics, but the type of treatment those batteries were subjected to during storage, as one might use if he were attempting to recharge old or wornout batteries. And our test in that respect was conclusive; there was no difference. Now, if the Weber effect is real, it is possible that there might be some insignificant difference in charging characteristics. But——

Q. Would that be———A. That we are interested enough in it to want to check it, and also, because of the interest of various other groups in this problem, we are willing to check that particular point.

Q. Would you say that anything Weber reported or that the new tests will cover would affect any conclusion as to whether AD–X2 reduces the harmful effect of sulfation and extends the life of the battery?—A. No; I—the verification of the effect Weber reported would have no direct bearing on those claims.

Q. Well, I am asking you this because that is one of the issues here. And what would you say as to Weber tests as to whether the product would combat sulfation which causes, that is, the kind of sulfation that causes battery failure?—A. It would conceivably have some relation to it, but it would be a long way from proving that that would be the effect.

Q. It has———A. By that I mean, even assuming the effect he got is real it is still, and I have considerable doubt of that, but even assuming that it is real, it is still a long way from establishing any good properties for the battery additive.

Q. Would it—would you say the same thing about the problem of dissolving sulfation?—A. Well, you might recall that during those discussions, Dr. Weber claimed that the same type of thing should be observed for ordinary mixtures of magnesium and sodium sulfate and I think it is well established or has been well established for many years that those materials have no value on the performance of batteries. And he made a great point of pointing out that this particular effect he was reporting should be observed by those materials as well as by AD–X2. So even if it is real, it is a long way from establishing any merit to the—for the additive.

Q. Now you mentioned this statement by Dr. Weber, and it brings me to a question which occurs. Do you see any, and from your study of this AD–X2 and the various experiments, do you see any essential difference between the characteristics of AD–X2 and ordinary previously examined or studied mixtures of magnesium sulfate, sodium sulfate?—A. There is no reason that I know of or that any member of our staff knows of as far as I have been able to determine why there is any significant difference between the two. These two consultants which are favoring the battery additive of—are attempting to promote elaborate theories why there might be a difference, but they have still got to establish that it does something and that has not been established yet.

Q. Well then, it is safe to say, Doctor, that in order to determine this question of the utility or the actual usefulness of AD–X2 for the purposes on which the Bureau has already furnished the Post Office Department results, that the Post Office Department at this time may accept those reports of the Bureau of Standards and rely upon them?—A. I would say they could; yes.

Mr. O'BRIEN. That is all the questions I have for the Doctor, if Mr. Haynes has any.

HEARING EXAMINER. I have only one, Doctor, it will clarify perhaps some background for me. One cannot read the literature that is issued in this case by the respondent with its claims for AD–X2, without—and its accompanying testimonials from big contracting firms and builders, that is, a lay person cannot, without getting some terrifically expanded idea that here is something after all that perhaps has this so-called catalyst that he talks about which may have eluded the Bureau of Standards in its testing over a period of some 25 years. Now, what is the—how did this idea first get started, if you know, of the use of magnesium and calcium sulfate in the storage battery? What was it they thought to accomplish there? What is the chemical rationale?

Mr. O'BRIEN. Sodium sulfate.

HEARING EXAMINER. What?

Mr. O'BRIEN. Sodium, not calcium.

HEARING EXAMINER. I beg your pardon, sodium sulfate.

The WITNESS. I really don't know. I think some of our chemists do. It is supposed to have some effect on making more soluble the lead sulfate which forms on the battery electrode during discharge. It was supposed to have some effect on making that more soluble or converting it back into lead and lead dioxide which are the active elements of the two electrodes in the storage battery. That is, when the storage battery discharges, the lead and lead dioxide on each plate convert to lead sulfate and recharging the battery converts the lead sulfate back to lead and lead dioxide. In a battery that is hard to charge, there is some difficulty in converting this lead sulfate back to lead and lead dioxide. Some people felt, I guess, that due to some sort of mysterious interaction of the ions, that the sodium and magnesium sulfate which are soluble in the battery electrolyte would have some effect on increasing this conversion of lead sulfate to lead and lead dioxide, first by making it soluble in the electrolyte. Your question is very difficult to answer——

HEARING EXAMINER. I realize that, doctor.

The WITNESS. You would say, that the procedure has no sound scientific basis and since there is no rational way of explaining the possible effects of this material, it is difficult to explain what the proponents of these materials hope to accomplish by their use.

HEARING EXAMINER. And in your conference with Mr. Ritchie and Mr. O'Brien, that is for the Respondent and the Government, do I understand that Mr. Ritchie stated that probably—that he stated in his behalf that while nobody knew, including Dr. Weber, and they couldnt' explain how this AD–X2 went into the battery to accomplish the results claimed, yet it actually did do that. Do you recall any such statement made or——

The WITNESS. Well, I think they made some statement that it must do something like that, but I think you have to examine the experience of all people who have written testimonials on this battery additive and are claiming that it is good or has beneficial effects. In all cases where they attempted to—at least all cases that have come to my attention—they would take a battery which they tried to charge and during the time they tried to charge it, it wouldn't take the charge. Then they added AD–X2 and put it on charge again and that took the charge. In no instances did they have enough foresight to run two or more batteries along parallel in which the AD–X2 was added only to half of them. That would be a controlled experiment and I think it is pertinent to cite our experience with the batteries we used in this last test, the so-called

suicide test. We obtained them from one of the other Government agencies and we were informed by them that the batteries would not take a charge and they were no good. If we had put the AD–X2 in all of these batteries we would have duplicated the experiments of the proponents of the battery material. However, we put the AD–X2 in only half of them and those that had the AD–X2 in them performed no differently than those that didn't have it. And I cite that because you see, if we had run our experiment a little differently we could have got into the same trap that most of the other people have got in. Nobody else has run a controlled experiment. And in the absence of any controlled experiment showing the merit of the battery additive I find it difficult to give any weight to any of the testimonials.

HEARING EXAMINER. Thank you, Doctor, that is all I have to ask.

Mr. O'BRIEN. Just a minute. Did you ask the doctor if Mr. Ritchie's chemist had offered to explain the phenomenon he claims——

HEARING EXAMINER (interposing). That was the point of my question. I think I asked it another way.

Mr. O'BRIEN. Well, I might say that is my recollection. If my recollection, is it yours, Doctor, that Dr. Weber said, frankly he could not explain anything, he just saw it happen?

The WITNESS. Yes, that was the summary of Dr. Weber's observation, I think——

Mr. O'BRIEN (interposing). That is all.

The WITNESS. Well, I would like to add to that.

HEARING EXAMINER. Go ahead.

The WITNESS. During the course of this meeting, Dr. Weber seemed to give considerable more credence to the scientific conclusions which he attempted to draw from the experience of battery servicemen than he did to the observation of our organization, and any man that does that, I would question his scientific conclusion.

Mr. O'BRIEN. As a matter of fact, Doctor, in that respect, he took the reports of dealers who reported what they considered to be the favorable reports of purchasers and users. He didn't even get it from the users, isn't that so?

The WITNESS. Well, as I understand it, he was introduced to this product initially through a battery dealer and serviceman up in Boston or Cambridge that he was acquainted with, and he gave considerable credence apparently to the claims and statements of this battery serviceman.

Mr. O'BRIEN. I have no further questions.

HEARING EXAMINER. It is not your information, that he himself personally discovered this as an act of creative inventiveness, is it doctor?

The WITNESS. No, I don't think so. And I also think the man is sincere in his objection and I don't think he—I just think he is misguided.

Hearing EXAMINER. Thank you very much, that is all I have, Dr. Astin.

AFTERNOON SESSION

The CHAIRMAN. The committee will please come to order, and Dr. Astin will resume the stand, please. Dr. Astin, if you will take your chair, we will proceed.

I know that some of the other committee members are on their way here, but in order to conserve your time and the time of everyone else until the other members of the committee return and, more especially, Senator Ferguson, because he was asking questions at the time we recessed, we will resume.

Dr. Astin, I do have a few questions that I could ask of you while we are waiting for the others in order that we may endeavor to clarify the record. There was this one question, Doctor: On page 11 of your statement yesterday you stated that, and I quote:

In the battery field we work closely with various experts in the battery industry, both in the development of new principles and techniques for new and improved type of batteries, and in the development for more reliable techniques.

Could you be more specific, Dr. Astin, and tell us just who these experts are in the battery field with whom you work so closely? That was one question that, I think, the record should show specifically.

TESTIMONY OF ALLEN V. ASTIN—Resumed

Dr. ASTIN. Well, I couldn't give you, Mr. Chairman, the names of specific individuals. I gave that as an example representative of our overall operation.

The experts in this particular area are working, in many instances, in the battery industry, and the way science progresses is to have experts to get together and talk over mutual problems. That is the nature of our contact with these engineers and scientists in the battery industry.

The CHAIRMAN. So that the engineers and the technicians working in the manufacture of batteries are in close contact with the scientists within the Bureau of Standards in order to exchange notes and to develop the ideas and possible further research in the field of better batteries?

Dr. ASTIN. That is correct.

The CHAIRMAN. You work very closely, so that over a period of many years you become very close associates in that respect?

Dr. ASTIN. Well, I can give you one example from my own personal experience. During the past war we were concerned with the development of special types of batteries for use in proximity fuses, and I was involved in some stages—not of the development of these batteries but in the development of evaluation techniques for them, to make sure they would function properly when the battery was shot in a rocket, for example.

Visits to the Bureau of engineers in the battery industry were very frequent, and, also, people from our laboratory would frequently go to the industrial laboratories; that is, we had mutual problems. We were striving for a common objective, so it is only natural that these people get together.

The CHAIRMAN. Doctor, there was one other statement that was made yesterday relative to the batteries that you used in the research project. They were acquired from a governmental agency as discarded batteries?

Dr. ASTIN. Yes, sir; that is true.

The CHAIRMAN. This is not a catch question, Doctor. The purpose of this question is—I am going to try to find out what governmental agency would discard a battery that you found to be all right and which would take a charge and would render a service after you charged it. Now, if the governmental agencies are so fussy and so careless that they will lay aside and throw away a battery that you say is all right and will take a charge, then I am going to try to find out from what agency these batteries were obtained because, if they are that fussy, then maybe we had better be a little tighter with the money that we give them. That is the purpose of this question. It is not related to you, Doctor, and it is not a catch question, so if you can tell us what governmental agency it is, we want to find out how often they do throw away batteries that you find to be all right.

Dr. ASTIN. We got them from one of the navy yards—I don't recall right now which one it was—and I think we actually paid for them.

The CHAIRMAN. That is true, but they were, nevertheless, discards?

Dr. ASTIN. They told our people that the batteries wouldn't take a charge.

The CHAIRMAN. That they would not?

Dr. ASTIN. That is correct. I cite that as an example of the experience of lots of the people with batteries. I feel that there is a great deal of room and opportunity for education of battery people—I mean battery technicians, and so on—in the proper handling of batteries.

The CHAIRMAN. But, Doctor, in that particular field we know that there are fairly good servicemen in most of these oil stations and garages and they have the instruments and they take a reading, and a man is not going to change just because he may anticipate trouble; he does not make a change until he has trouble. I am now speaking as one who has had to change batteries in his automobile and I never did it until I was positively certain that the battery would not take a charge and that it was absolutely worn out. I think that that is the average action of people, whether it be the press or whether it be a member of the legislature, and it certainly is with the average man who is operating on a pretty close budget. But the question that I have in mind here is, Did this governmental agency set aside these batteries and were they marked as batteries that would not take a charge? You put them on the line and they took a charge, and they performed, whether they had the additive or did not have the additive?

Dr. ASTIN. That is correct.

The CHAIRMAN. If this battery that was found to have been discarded by a military organization did have serviceability to it, then we had better find out how often they throw away batteries with the anticipation that it might give them trouble in the next 6 months. That is what I am getting at and that is why I want to know what agency of Government, whether it be military or otherwise, from which you procured those batteries. I want to follow this up and find out how often the military does throw these batteries away when they have, or may have, 6 months of service left in them.

Dr. ASTIN. Well, these batteries had not been actually discarded, but they were not in use and they were considered not suitable for use. That much I do remember about it.

The CHAIRMAN. They were not recognized as serviceable batteries?

Dr. ASTIN. That is correct.

The CHAIRMAN. But they were discarded batteries that were picked up, and you picked up how many of them?

Dr. ASTIN. I think there were approximately 30 altogether.

The CHAIRMAN. You picked up 30 batteries altogether and they were no longer considered serviceable batteries?

Dr. ASTIN. Yes.

The CHAIRMAN. You gave them a test, and you found that, whether they were treated or not, they were serviceable batteries; they held their charge. I do not recall your testimony exactly, but it seems to me that you said they held their charge for a considerable length of time after you had charged them?

Dr. ASTIN. It is my recollection from the data that they definitely weren't as good as new batteries, but they had something like two-thirds of their initial capacity left.

The CHAIRMAN. They had been thrown away by the military organization?

Dr. ASTIN. Not thrown away, sir.

The CHAIRMAN. But they were set aside as not serviceable batteries?

Dr. ASTIN. Yes, but there is a bit of a difference.

The CHAIRMAN. Technically.

Dr. ASTIN. Yes.

The CHAIRMAN. But that is where you have always got us as a scientist because you can get into that technical field, and we are left somewhat in a daze; we are not sure whether we dare challenge you or not, you see. Nevertheless, these batteries, as you charged them, according to your testimony yesterday, held their charge?

Dr. ASTIN. That is right.

The CHAIRMAN. If my memory serves me correctly—I may now be in error—I thought you said you checked those batteries over an interval of several months, and they continued to hold their charge?

Dr. ASTIN. Yes; we checked them again this year.

The CHAIRMAN. And they are still holding a charge?

Dr. ASTIN. Well, they were stored in a discharged condition, I believe, during most of that interval. They can be charged up and left standing a while and then discharged with energy still in them.

The CHAIRMAN. Doctor, you will agree that a discharged battery will rapidly deteriorate by the very fact that the acid is then free to work on the plates, is that not true, unless you put them in dry storage for positive dry-storage purposes? If you let a battery that has lost its electrical charge stand for any length of time, that battery will deteriorate by the mere fact that the acid goes to work and eats that battery up; whereas, a charged battery will stand for quite a lengthy period without being destroyed by its own acidity; isn't that so?

Dr. ASTIN. No; a charged battery will discharge itself just on standing.

The CHAIRMAN. Certainly, we know that.

Dr. ASTIN. So if you store a fully charged battery it will tend to run down.

The CHAIRMAN. When its gets to zero, Doctor, a battery will rapidly deteriorate, much faster than if it is a charged battery. I am now talking not as an expert but as to what I have been told when I had the sad experience of having a battery ruined because they said it had been left standing without charge and ate itself up—acid-eaten. Therefore, I am terribly surprised, Doctor, that you can run a test back here in 1952 on a discarded battery, a battery that a Government military agency discarded, and you tested it, used it as a scientific test basis, and that it is still a serviceable battery now in June of 1953. And you ran your tests back there in 1952.

Dr. ASTIN. That is right.

The CHAIRMAN. So I think we need to check the military to see how wasteful they are with their storage batteries because they are not in a critical situation here so that they need to discard a battery when it still may have 6 or 8 months of service in it. That is the only reason I asked you these questions, not to try to cross-examine you. Will you furnish us the information as to what military agency you obtained those batteries from, because we are going to check on just how the military uses these batteries, and when they throw them away, you see.

(In compliance with the chairman's request, Dr. Astin subsequently supplied the following information in letter of June 29, 1953, to the chairman:)

Pertinent information on the batteries is given in the following letter from Walter J. Hamer, Chief of the Bureau's Electrochemistry Section, on April 2, 1952, to the Bureau of Supplies and Accounts, Department of the Navy:

"On March 21, 1952, we wrote the Naval Aviation Supply Depot (attention C. G. S.–4), Philadelphia 11, Pa., about 25 6-volt Goodyear storage batteries, stock No. B270/YL780720–17–B–8913, which have been on storage for about 4 years and which we understood were ready to be declared surplus. On March 31, 1952, they replied that these batteries are in the category of activity excess material and are being referred on report NASD No. 496 of March 31, 1952, to your Bureau (Bureau of Supplies and Accounts, S–O), Navy Department, Washington 25, D. C., for further screening in accordance with existing procedures. They suggested that we contact you about their availability.

"We are anxious to receive these batteries as soon as possible for tests we would like to perform. We would like to receive them either as a transfer or on a reimbursement basis. In either case, please ship the batteries to the Electrochemistry Section, Building 69, National Bureau of Standards, Washington 25, D. C. If you are to be reimbursed, please let us know the estimated amount."

Senator FERGUSON. Doctor, did you examine these batteries when you obtained them, as to what was wrong with them?

Dr. ASTIN. One of our men participated in Mr. Ritchie's examination of these batteries.

Senator FERGUSON. Have you a report on what they found?

Dr. ASTIN. I believe they made a report on the condition of the batteries before.

Senator FERGUSON. Doctor, haven't you seen that report?

Dr. ASTIN. Yes.

Senator FERGUSON. Well, are you testifying now from your report?

Dr. ASTIN. I am not. It is not clear right now in my own mind whether my recollection of what was told me about the condition of those batteries was put in writing or whether it was given to me verbally. There was some reference made to it in the report which was written; I don't recall it.

Senator FERGUSON. Doctor, do you think that you have a basis of a test, and part of it would be verbal?

Dr. ASTIN. Well, the essential part of this, as far as the test is concerned, is that the batteries were in sound mechanical condition before we started, and that they were slightly sulfated.

Senator FERGUSON. All right. What batteries are you talking about; what tests?

Dr. ASTIN. I am talking about the test that the chairman was talking about, the one we ran last June.

Senator FERGUSON. All right. Now, that is the June test?

Dr. ASTIN. That is correct.

Senator FERGUSON. You obtained 30 batteries from the Navy?

Dr. ASTIN. Approximately that number.

Senator FERGUSON. Approximately 30. Where did you get the new batteries?

Dr. ASTIN. I don't know, sir. We ordered them through regular purchasing channels.

Senator FERGUSON. Did you purchase them through some other department, or did you buy them new as experimental work?

Dr. ASTIN. The new batteries were used for the Federal Trade Commission, and I presume were purchased through normal purchasing channels.

Senator FERGUSON. Did you get the batteries through the Federal Trade Commission?

Dr. ASTIN. No. The batteries, I would feel fairly sure, were purchased by us. All we would get from either the Federal Trade or the Post Office would be the samples of the battery additive which we were to test.

Senator FERGUSON. Did you get the additive from the Federal Trade or from the Post Office?

Dr. ASTIN. Well, we got some from each.

Senator FERGUSON. Were you making this June test of last year for the Federal Trade Commission?

Dr. ASTIN. No. We were making this test last June to satisfy a number of interests. We were hoping to satisfy Mr. Ritchie; we were hoping to satisfy a number of Members of the Congress, including the House Small Business Committee; and we were hoping to satisfy ourselves, also.

Senator FERGUSON. Doctor, does the examination in the testing of the batteries show that when you received them they were the kind of batteries that the advertising or the claim of Ritchie, whatever it was, the Pioneer Co., could be benefited?

Dr. ASTIN. Well, one of the ——

Senator FERGUSON. You say these were discarded batteries by the Navy, and I thought your testimony showed that they would not take a charge and, therefore, they were discarded.

Dr. ASTIN. We were told by others that they wouldn't take a charge, and there was——

Senator FERGUSON. Doctor, if you are going to make a test of a battery are you going to take the word of what somebody else told you or are you going to scientifically make this experiment——

Dr. ASTIN. We did——

Senator FERGUSON (continuing). And keep everything down so that everything would be recorded?

Dr. ASTIN. We did that, sir.

Senator FERGUSON. When you got the batteries, was it your understanding that they would not take a charge?

Dr. ASTIN. That is what the prior owner told us.

Senator FERGUSON. That is what the Navy told you. Then, when you got them and tested them, does your record show they did take a charge?

Dr. ASTIN. Very definitely, sir.

Senator FERGUSON. All right. Now, did you overcharge them before you started the test?

Dr. ASTIN. They were given no charge prior to the initiation of this test by us.

Senator FERGUSON. Didn't you tell us this morning that you did charge them before you started the test?

Dr. ASTIN. Senator, we have conducted many tests on battery additives.

Senator FERGUSON. I am trying to keep it to the June test.

Dr. ASTIN. All right. I do not believe that I told you we gave a preliminary charge to the batteries in the June test, because we did not.

Senator FERGUSON. I see.

Dr. ASTIN. We did in some of the others.

Senator FERGUSON. What I am concerned with, as a Senator, is this fraud order that was obtained, whether or not this was obtained in the regular channel, whether it was a fair order.

Dr. ASTIN. Yes.

Senator FERGUSON. That is one of the things I think we ought to be concerned with—how the departments are functioning.

Dr. ASTIN. Surely.

Senator FERGUSON. Do you have the report of the test in June of 1952?

Dr. ASTIN. Yes.

Senator FERGUSON. Will you get it, please? Will you tell us the condition of the batteries, as shown by the report, prior to the test?

Dr. ASTIN. The report reads as follows:

The batteries were of the heavy-duty type commonly used in buses. The batteries had been in storage in a wet condition for about 4 years, and were received at NBS May 20, 1952. Each battery contained 6 cells assembled in a hard-rubber tray. The cells were connected in series-parallel to provide high capacity at 6 volts. All 25 batteries—

apparently it is 25 rather than 30.

Senator FERGUSON. Instead of 30.

Dr. ASTIN (reading):

All 25 batteries were delivered by NBS truck to a commercial battery shop on May 27 where the batteries were dismantled and inspected. One packing crate containing a single battery was opened at the NBS when the shipment was received. Six additional crates containing 4 batteries were opened in the presence of the manufacturer upon their delivery to the battery shop. A preliminary inspection of the batteries revealed raised positive terminals in 3 batteries. Raised terminals indicate expanded and unsound positive plates, therefore these batteries were rejected. The remaining 22 batteries passed the preliminary inspection. Upon removing——

Senator FERGUSON. Who was present at that inspection? What does the report show?

Dr. ASTIN. There are no names listed of our staff in the report.

Senator FERGUSON. You had the manufacturers present?

Dr. ASTIN. Yes.

Senator FERGUSON. What did they have to do with this test?

Dr. ASTIN. One of the basic considerations in this test is that the batteries would be acceptable to Mr. Ritchie as suitable for the purpose of the test.

The CHAIRMAN. Was Mr. Ritchie present?

Dr. ASTIN. Oh, yes; he was present when this was inspected.

Senator FERGUSON. Does the report show he was present when this work was done?

Dr. ASTIN. I believe it does; yes.

Senator FERGUSON. What does it say?

Dr. ASTIN. It says:

The plates in the 16 batteries which remained were in sound mechanical condition, and the manufacturer approved these batteries for use in the test.

The CHAIRMAN. But the NBC——

Dr. ASTIN. NBS, National Bureau of Standards.

The CHAIRMAN. The National Bureau of Standards, that is what you meant by that—that they were accepted by the National Bureau of Standards?

Dr. ASTIN. And the manufacturer.

The CHAIRMAN. And by the manufacturer?

Dr. ASTIN. That is correct.

Senator FERGUSON. What manufacturer?

Dr. ASTIN. Mr. Ritchie, the manufacturer of AD–X2.

The CHAIRMAN. Of AD–X2?

Dr. ASTIN. Yes. That may not be clear here, but that is the manufacturer.

Senator FERGUSON. I did not catch it from what you read. I thought it was the manufacturer of the batteries.

Dr. ASTIN. No. This is a test on a battery additive, and so it was assumed in writing this report, when we referred to the manufacturer, it would be the manufacturer of the additive.

Senator FERGUSON. Of the product.

Dr. ASTIN. Yes.

Senator FERGUSON. All right. Now, these batteries; that shows they were 4 years old?

Dr. ASTIN. Yes, sir.

Senator FERGUSON. Did it show when they had been discarded?

Dr. ASTIN. No; it doesn't show that; the report does not show it.

Senator FERGUSON. The report does not show that?

Dr. ASTIN. No, sir.

Senator FERGUSON. You said they were in wet condition, meaning that they had acid in them?

Dr. ASTIN. That is correct.

Senator FERGUSON. Was there any charge in them when you obtained them?

Dr. ASTIN. I would presume they were discharged because the presumption was that they would not take a charge.

Senator FERGUSON. The presumption was they wouldn't take a charge?

Dr. ASTIN. Yes; so that they were, therefore, and would be in the uncharged state.

Senator FERGUSON. Is the first thing the Bureau does with them to charge them; is that what the report shows?

Dr. ASTIN. After they had been inspected and returned to the Bureau as approved for the test, then they were connected in the charging circuits. The charging——

Senator FERGUSON. Give us the report; don't vary from the report. Let the report speak for itself. What did you do with them?

Dr. ASTIN. I have to find it then. [Reading:]

> The manufacturer then inspected the charging circuits and testing equipment and left the laboratory. The charge was started at 11 a. m., and after adjusting the charging currents to 5 amperes the laboratory personnel left the laboratory.

Senator FERGUSON. Was there material put in before you started the charge?

Dr. ASTIN. There was no material put in at that time.

Senator FERGUSON. All right. Does the report show that?

Dr. ASTIN. Well then——

The CHAIRMAN. I would like to raise this one question, Doctor: Was the manufacturer asked to leave the laboratory or did he leave on his own accord?

Dr. ASTIN. He was asked to leave.

The CHAIRMAN. In other words, he was asked to leave the laboratory after the connections had been made?

Dr. ASTIN. That is correct.

The CHAIRMAN. Then, was he permitted to come back during the period of the test?

Dr. ASTIN. His representative was permitted to come back.

The CHAIRMAN. His representative was there when the additive was put into the batteries?

Dr. ASTIN. No, sir.

The CHAIRMAN. He was not present?

Dr. ASTIN. No. As I explained in my general statement, we went to great length in this test to make sure that none of the people running the test would know which of the batteries had been treated.

The CHAIRMAN. And at no time throughout the test period was Mr. Ritchie, the manufacturer, permitted to observe what was being done?

Dr. ASTIN. No. Let me go on with this.

The CHAIRMAN. In order, sir——

Dr. ASTIN. In order to make sure that none of the people participating in the test knew which batteries had been treated, all of the laboratory personnel, and Mr. Ritchie and his representative, left the laboratory. Then I had a young technician from another part of the organization assist me in putting the additive into half of the batteries, according to a pattern which had been given us by our statisticians. Then this young man left, and I proceeded to assign numbers and mark the batteries which had been treated, and took the code, this code, and put it in my safe. Then when this was done the people came back in and continued the running of the test. This meant that nobody other than I knew which of the batteries had been treated.

The CHAIRMAN. When you said "according to a pattern," did I understand you to say it was according to a pattern of the technician?

Dr. ASTIN. No. This was a pattern of selecting batteries at random for treatment.

The CHAIRMAN. I see.

Dr. ASTIN. This is a requirement in good statistical design.

The CHAIRMAN. In other words, he said, "You take this battery and that battery." He was not in charge of the preparation of the chart that you put away in your safe?

Dr. ASTIN. That is correct.

The CHAIRMAN. He did not tell you how to add the additive, did he?

Dr. ASTIN. Mr. Ritchie gave me instructions as to how the additive was to be added.

The CHAIRMAN. So you followed Mr. Ritchie's instructions?

Dr. ASTIN. That is right.

The CHAIRMAN. You did not follow the technician's instructions?

Dr. ASTIN. Well, he instructed me and the young man who was helping me as to how to put the additive in, and the two of us put it in the batteries selected for treatment.

The CHAIRMAN. You mean it was not the technician now, it was the manufacturer whose instructions you were following?

Dr. ASTIN. That is right.

The CHAIRMAN. Not the technician's instructions?

Dr. ASTIN. That is right.

Senator FERGUSON. Doctor, then you do know whether these batteries were overcharged when you put that material in?

Dr. ASTIN. What do you mean by that, sir?

Senator FERGUSON. Well, just what I said.

Dr. ASTIN. The material was put in the batteries at the beginning of the charging process; that is, in accordance with instructions they were not overcharged. These batteries were charged for a period of about 4 days, and the material was put in during the first hour or, perhaps, half hour of charge.

Senator FERGUSON. All right.

Then, were you present when the charge was started and carried on?

Dr. ASTIN. That is right.

Senator FERGUSON. Some of the batteries did not have material in them?

Dr. ASTIN. Correct.

Senator FERGUSON. Will you tell us whether or not all batteries took charges?

Dr. ASTIN. Yes; they did.

Senator FERGUSON. Notwithstanding that they came to you—that they would not accept charges?

Dr. ASTIN. That is correct.

Senator FERGUSON. Then you tested later, after the material was in, and a charge—did all batteries receive the same charge or take the same charge?

Dr. ASTIN. Yes, they did; within no consistent pattern of differences.

Senator FERGUSON. So these 4-year-old batteries of the common kind they use in a truck, all took a charge?

Dr. ASTIN. Correct.

Senator FERGUSON. Will you tell us the readings, some of them?

Dr. ASTIN. Well, the readings——

Senator FERGUSON. Of these batteries which were 4 years old, and which they took?

Dr. ASTIN. Yes. The readings we have in here are expressed in watt-hours.

Senator FERGUSON. Usually, when they test your battery at the service station they tell you a certain reading, specific gravity, to show the charge. Have you got anything like that?

Dr. ASTIN. These went up to—well, yes, we have that data, too, but the watt-hour reading is the more reliable and better estimate of the capacity of the battery.

Senator FERGUSON. You would say from the report they practically all took the same charge?

Dr. ASTIN. That is correct.

Senator FERGUSON. Then, when did you next test them to see whether or not the additive was of any value?

Dr. ASTIN. I think it was in December or January.

Senator FERGUSON. Now, wait, there is something wrong here. If this is the June test we are talking about, you used that test to get a fraud order in October. Now you say you did not know the results of the test until December or January of this year.

Dr. ASTIN. The information on these later tests was not a factor in the Post Office's action. It was additional supplementary information we obtained on our own just because of the general interest in the subject.

Senator FERGUSON. All right. Now, we find that the June test had nothing to do with the fraud order.

Dr. ASTIN. No, sir; I didn't say that.

Senator FERGUSON. What do you say?

Dr. ASTIN. I said that we ran a complete set of tests in June and prepared a report on these tests, and a copy of this report was given to the Post Office Department at their request.

Senator FERGUSON. When?

Dr. ASTIN. I would guess they got the report in July of last year.

The CHAIRMAN. Then, Doctor, how many batteries were used in that test in which you made your findings known to the Post Office Department?

Dr. ASTIN. In this test we ran last June?

The CHAIRMAN. Yes; the one that you based your findings on, and the Post Office used in their determination on whether a fraud order should be issued or not.

Dr. ASTIN. There were 16 six-cell batteries.

The CHAIRMAN. Sixteen six-cell. Were those the 16 six-cells that you have just now referred to?

Dr. ASTIN. Well, we have been talking about this group, that is, these were 16 six-cell batteries out of the original group of 25.

The CHAIRMAN. Yes. That was the basis on which you ran your test for which the Post Office Department determined their fraud order on?

Dr. ASTIN. This was one of the factors, I understand, involved in their decision, but I think the major factor was the test we ran specifically for them the preceding spring or winter.

The CHAIRMAN. Then when did you tear those batteries down? I am now leading up to your last statement to Senator Ferguson as to when you tore those batteries down.

Dr. ASTIN. Well, the batteries, after the June tests were completed, June 1952 tests were completed, the batteries were stored and then we got them out again this past December and January, following the release of the MIT report, and used them to attempt to check some of the phenomena reported by MIT.

The CHAIRMAN. Then, in other words, you ran a test 1 week, as you stated yesterday, and then you let them sit and discharge for a week, and took your readings on it during the period of discharge so that you actually had 2 weeks, a 2-week period that you actually took your readings off the batteries, which was the basis on which the Post Office Department made their determination for a fraud order?

Dr. ASTIN. It is my understanding that it was one of the factors.

The CHAIRMAN. One of the factors; and the other factor would be based on what?

Dr. ASTIN. The other factor would be on the test which we ran specifically for the Post Office Department.

Senator FERGUSON. That is the one they turned down; that is the test that they turned down and said they could not use.

Dr. ASTIN. No, sir. There have been a lot of tests run, and I think we are apt to be a little confused with them.

The CHAIRMAN. Well, Doctor, the other test was then run on how many batteries? We have got a group of 16 batteries here. The other test was run on how many batteries? Apparently you are using two different tests here from which the Post Office made their determination.

Dr. ASTIN. That is correct.

The CHAIRMAN. If you used 16 in the later test, how many did you use in the first test?

Dr. ASTIN. It is my recollection that it was 14 three-cell batteries in the former test for the Post Office Department, which included 8 used batteries and 6 new batteries.

The CHAIRMAN. Eight and 6 and then you went on and you ran this block here of 16?

Dr. ASTIN. Yes, sir.

The CHAIRMAN. But you did not get your final readings off the 16 until about 6 months later?

Dr. ASTIN. Well, we got all of the readings that were necessary to fulfill the requirement of the test proposed by Mr. Ritchie during the month of June, and then just for our own information, and to see what had happened to them after a 6- or 8-month storage, we checked them again this past winter.

Senator FERGUSON. Doctor, isn't one of the things, as I remember their saying, the length of life of a battery—that this extended the life?

Dr. ASTIN. Yes, sir.

Senator FERGUSON. How could you tell in a month or 2 weeks whether or not the life was being extended?

Dr. ASTIN. That particular test would, of course, give no direct evidence on an extension of the life of a battery. It would give evidence on the charging efficiency of a battery. Now, the charging efficiency is one of the very important characteristics that has to be measured.

Senator FERGUSON. Suppose they were right on the life, the length of the life, that it increased the life?

Dr. ASTIN. Well, the information on the life comes from other measurements of—well, a life-cycle test which was run in January 1949—that is probably the nearest thing which approaches an estimate of life of a battery.

Senator FERGUSON. Yes. But, Doctor, we have not any evidence on that test, whether it was done in accordance with the rules as prescribed by the manufacturer of the product; have we?

Dr. ASTIN. Not on that January 1949 test.

Senator FERGUSON. What I am getting at is how the Post Office would issue a fraud order on this kind of evidence when the question of the length of life was involved, and they had turned down your previous inspection or test on it. Then you come in, and in a couple of weeks you start a new test, and you give them the information, and in October they issue a fraud order.

Dr. ASTIN. I think the major claim which is made for this product is that it eliminates the harmful effects of sulfation.

Senator FERGUSON. Well, suppose some of the minor ones are right, the length of the life?

Dr. ASTIN. Well, there are other data which show very definitely that it does not affect the life characteristic.

Senator FERGUSON. You mean in 2 weeks.

Dr. ASTIN. No, sir; not in 2 weeks.

The CHAIRMAN. Doctor—if you will permit me to interrupt, Senator Ferguson—how would you obtain that other data?

Dr. ASTIN. This is done—the estimate on effect of life can be obtained through a life-cycle test.

The CHAIRMAN. How do you determine a life cycle?

Dr. ASTIN. There is a test which is developed by the Society of Automotive Engineers, and used extensively throughout industry for estimating the expected life of batteries. It is used by the Government in connection with its procurement. Now, it is also used by battery manufacturers in their design of batteries. For example, most battery manufacturers will make batteries for 12 months, 18 months, 24 months, 36 months guaranty and they know pretty well in the industry how to change the design of the battery in order to obtain these longer lives, and they use these life-cycle tests in order to assist them in designing the battery to meet the expected life which they guarantee for the battery. Now that is, I think, a fairly good evidence that these life-cycle tests are useful in estimating life performance.

Senator FERGUSON. Doctor, I would like to go to another subject.

Dr. ASTIN. Yes, sir.

Senator FERGUSON. Because of some testimony in the record about the obligation of the Bureau of Standards, being a member of the Appropriations Committee, I am concerned with what the purpose of the Bureau of Standards is.

Dr. ASTIN. Yes, sir.

Senator FERGUSON. I am concerned with the possibility that the National Bureau of Standards may become—may be used as a regulatory body of proprietary products. Do you think that is possible with what has happened in this case?

Dr. ASTIN. Well, first, we do not have any regulatory authority or responsibility, but we do——

Senator FERGUSON. Well, you can regulate pretty well through the Post Office fraud order, can you not?

Dr. ASTIN. That is not our initiative, sir. All we try to do is to assist them on a technical problem.

Senator FERGUSON. I say, you can, though—you can have cooperation between the Post Office and your Department or the Federal Trade, and you can do pretty well on regulation, can you not?

Dr. ASTIN. I don't know how we could take any responsibility for the regulation when that belongs to them. We try to give them technical information to help them, but they are doing the regulating, not us.

Senator FERGUSON. Then, you would say that you do not think it ought to be denominated a regulatory body?

Dr. ASTIN. We don't want to be a regulatory body; we are a fact-finding organization.

Senator FERGUSON. All right. Now, yesterday you referred to Public Law, I believe, 619 of the 81st Congress, which authorizes the Bureau to engage in, and I quote:

> * * * the compilation and publication of general scientific and technical data resulting from the performance of the functions specified herein or from other sources when such data are of importance to scientific or manufacturing interests or to the general public, and are not available elsewhere.

Dr. ASTIN. Yes, sir.

Senator FERGUSON. That is about it, is it not?

Dr. ASTIN. That is it; that sounds exactly it.

Senator FERGUSON. Do you construe that to place any obligation on the Bureau of Standards to release information when it is relevant and economically important to the interests of industry, commerce, or the general public?

Dr. ASTIN. I would say that that is a responsibility we have in the light of that legislation.

Senator FERGUSON. You claim that would be your responsibility to release that?

Dr. ASTIN. Yes, sir.

Senator FERGUSON. Is it not a question, then, of whether you should continue to prepare for dissemination and/or publication the general data relating to types of commercial products of interest to the general public or whether you should limit your publications to matters of interest to science and technology, broadly speaking, and to manufacturing interests at the technical level, of the producers of goods?

Dr. ASTIN. Well, one can make a choice between those. I think either level is in accordance with the legislation.

Senator FERGUSON. Either one? Well, Doctor, if you were to carry out what you say now is the function, you would require how much to be appropriated per year to do the testing of all the ramifications of products?

Dr. ASTIN. Testing for whom and for what purpose?

Senator FERGUSON. Well, you test it for a purpose here, a better business bureau, which gets in touch with you, and they get you to test the product. Then, do you not owe it to the public to test all products that are brought to you by the public?

Dr. ASTIN. We don't do testing for the public, sir, of that sort.

Senator FERGUSON. Well, you did it for the better business bureau; why shouldn't you do that for me as a member of society? What is the difference between the better business bureau and Joe Doaks?

Dr. ASTIN. This test was not done for the better business bureau, sir.

Senator FERGUSON. Now, didn't you do these tests and get 302 out?

Senator SPARKMAN. 504.

Senator FERGUSON. And 504?

Dr. ASTIN. I said the first tests the Bureau made on this particular product were initiated in January 1949.

Senator FERGUSON. For whom were you doing it?

Dr. ASTIN. This was done for the Bureau's own information, but the interest in it had been stimulated to some extent by the fact that Senator Knowland had suggested that if it were in line with Bureau policy to do this, then it might be done, and the Oakland Better Business Bureau, in pressing Mr. Ritchie's claim, suggested we ought to do it. I mean, those factors may have stimulated to some extent the first test the Bureau made on this project, but the fact that a test was currently being done for the Federal Trade Commission on another additive, made it possible at practically no increase in cost, to put in the second additive and get some information on it.

Senator FERGUSON. Is it not possible then, under the same circumstances that there would be thousands of articles that you would have to test for the public under the same or similar circumstances, and they would be entitled to it? What singles this out to give this a priority?

Dr. ASTIN. The thing that singled this particular thing out, as I thought I had explained, was that there happened to be another battery additive being tested, and it could have been included in that. That was the first test that was made. All the subsequent tests were

made at the request of the Post Office Department and the Federal Trade Commission.

Senator FERGUSON. All right. Has the basic question of policy that we are discussing now been discussed by the Bureau staff?

Dr. ASTIN. I have discussed this matter with various senior people in the Bureau staff; yes, sir.

Senator FERGUSON. Are any of the discussions in writing, any record or reports made on it?

Dr. ASTIN. The only thing that is in writing on this particular subject or the only thing I am aware of is a memorandum which I sent to the Assistant Secretary of Commerce last March asking for policy guidance on this question.

Senator FERGUSON. Then you thought this was a matter that the Commerce Department, under whom your department is, should give you guidance and determine the policy?

Dr. ASTIN. Oh, very definitely.

Senator FERGUSON. Have you determined the policy, yet?

Senator SPARKMAN. Senator, may I ask Dr. Astin—you said "last March;" was that March 1952 or 1953?

Dr. ASTIN. 1953.

Senator FERGUSON. Did you get a policy laid down?

Dr. ASTIN. No, sir.

Senator FERGUSON. Do you think that the National Bureau of Standards by following its policy of disseminating technical data, when not specifically directed toward scientific or technological progress, at the professional and production level, is broadening gratuitously and, perhaps, inadvertently, into a regulatory activity?

Dr. ASTIN. Indirectly it might be so construed, but——

Senator FERGUSON. Would it not be, as a matter of fact, a regulatory activity? Isn't that what this has amounted to?

Dr. ASTIN. Well, one can extend that and say that, similarly, all progress in science and technology is regulatory. The invention of the incandescent lamp bulb made obsolete gas lights and so on, so that if you carry this too far, then you would never disseminate any scientific information because it might have some effect on curtailing the marketing of some products that it is related to.

Senator FERGUSON. So then you believe that the law now authorized exactly what you did in this additive case?

Dr. ASTIN. Yes, sir.

Senator FERGUSON. Do you believe that the Congress intended to grant authority to the Bureau of Standards personnel to prepare material at the request of and for publication by private organizations for commercial use?

Dr. ASTIN. Well, I am not sure that the Congress intended that to be done.

Senator FERGUSON. Isn't that exactly what you did?

Dr. ASTIN. Well, a statement was given——

Senator FERGUSON. Isn't that one of the irregularities in this whole procedure?

Dr. AUSTIN. A statement was given to the National Better Business Bureau for them to use; it was a statement of technical information.

Senator FERGUSON. And it was to be used for commercial uses, because they have members who are interested in commerce?

Dr. ASTIN. That is right.

Senator FERGUSON. And you say Congress never intended that?

Dr. ASTIN. Well, Congress provided for the dissemination by the Bureau of scientific and technical information.

Senator FERGUSON. Yes, but doesn't all your correspondence indicate that this was being done for another purpose and not for scientific purposes? It was being done for a commercial purpose, and is it not true it was to meet a competitive threat which would be extending the life, as claimed by this man, of a battery?

Dr. ASTIN. Well, consider the alternative position.

Senator FERGUSON. No, but I am asking you now the question: Did Congress so intend that you would get into this competitive field, and that you would disseminate this news, this information for commercial uses?

Dr. ASTIN. All I can do is go back to the law which we read many times. It provides for the dissemination of information when it is of interest to these groups. There is no requirement in there to determine the use that is to be made of it by these groups.

Senator FERGUSON. Does it not indicate by these letters that this was done for commercial purposes and not for scientific purposes?

Dr. ASTIN. The dissemination of technical information is serving the cause of science and technology, I think, Senator.

Senator FERGUSON. Do you want to leave your answers just where they are; is that the way you want to leave it?

Dr. ASTIN. I think so; I think that is all right.

Senator FERGUSON. All right. Now, the next question is, Do you believe then that the Bureau of Standards has authority to participate in an aggressive campaign to discredit any proprietary product?

Senator SMATHERS. Mr. Chairman, I did not hear that question.

Senator FERGUSON. Will you read the question?

(The question was read by the reporter.)

Senator SMATHERS. You know, if we were in a court of law, which we are not, somebody could make an objection to that question on the ground that it calls for a conclusion of the witness, and it assumes facts which have not been proven, and I am sure the court would strike it.

Now, this witness here, Mr. Chairman, I submit, is a scientist, and we are asking him for an opinion in a field which he does not profess at all to be an expert in, and I just——

Senator FERGUSON. Senator, if we were in a court of law I would have immediately objected to your suggestion to the witness.

Senator SMATHERS. Now, that may be, but, if we were in a court of law, he could not have asked the question, to start with, because——

Senator FERGUSON. Oh, yes.

Senator SMATHERS. (continuing). It would have been stricken.

Senator FERGUSON. What is wrong with the question, Doctor?

Dr. ASTIN. Well, it is somewhat difficult to answer.

Senator FERGUSON. I thought it would be by the conduct that had taken place in this case; I though it would be hard.

Dr. ASTIN. I believe that if one of the other Federal agencies is making an aggressive campaign for some purpose or other, and that Federal agency presents to us a straightforward technical question for an answer, that it is our responsibility to give them that information and not question the use they are to make of it.

Senator FERGUSON. Then you think that one of your duties is to——

Dr. ASTIN. Our duty——

Senator FERGUSON. Now, wait. You see, the fraud order, the Post Office was not asking for this information——

Dr. ASTIN. The Post Office Department was——

Senator FERGUSON. Wait until I get my question framed. So far as this one thing is concerned, the Post Office was not asking for it, the FTC was not asking for it, but a public—not a public—a private agency, the Better Business Bureau, was asking for it, and that is where your competitive spirit came in.

Senator SMATHERS. Mr. Chairman, again, I do not want to get into a hassle, but the witness testified the first time they submitted evidence to the Post Office Department was on request of the Post Office Department.

Senator FERGUSON. I am not talking about the Post Office; I am talking about what they did, according to the correspondence, when they prepared a new directive other than 302, which was many years old, and the correspondence between them—I am not asking what the doctor did, I want to know whether the Bureau has this authority, and you think that is the duty of the Bureau?

Dr. ASTIN. Well, the duty of the Bureau is to disseminate the results of its technical findings, and I don't think that we have either the means or the authority to question what people do with the information that they get from our findings.

Senator FERGUSON. All right.

Dr. ASTIN. This might get into questions, into the broader commercial questions, where the Secretary of Commerce has a broad interest, and in those cases I would say the Bureau should obtain policy guidance on those things from the Secretary of Commerce.

Senator FERGUSON. But you did not do it in this case; did you?

Dr. ASTIN. On this specific case I can't say that it was done, but the dissemination of this type of information has been checked many times over the years with prior Secretaries of Commerce, and the program of distributing this had their concurrence.

Senator FERGUSON. Will you give us the writings that that is in, the orders, and so forth, and their concurrence?

Dr. ASTIN. I think, in general, most of it was done verbally, sir.

Senator FERGUSON. Do you think that is the way to run a Government business, to have this authorized verbally?

Dr. ASTIN. I am not sure how specifically it was formalized, but it would involve, perhaps, a discussion with one of the prior Directors and one of the prior Secretaries as to whether or not this sort of publication program was in line with the policy which the Secretary of Commerce chose to establish. This was no departure from what the Bureau had been doing for the past 25 years.

Senator FERGUSON. Doctor, as a Director now of the Bureau, would you, knowing all this correspondence and what was done, conduct another case in the same way?

Dr. ASTIN. Under these circumstances, and as I did——

Senator FERGUSON. I am not talking about when you took office, but the whole thing.

Dr. ASTIN (continuing). Several months ago, I would ask the Secretary of Commerce for policy guidance.

Senator FERGUSON. You would ask the Secretary of Commerce now for policy guidance?

Dr. ASTIN. That is correct.

Senator FERGUSON. In other words, you would not approve this without the Secretary of Commerce's guidance?

Dr. ASTIN. That is correct.

Senator FERGUSON. That is all I have.

The CHAIRMAN. Senator Schoeppel was interrupted last evening, and I think the Senator had a few additional questions that he would have liked to ask.

Senator SCHOEPPEL. Did the test report you filed yesterday, Doctor, come as a result of a request from the Federal Trade Commission or the Post Office Department? I don't have that one point clear, I might add; or did it come from both of them?

Dr. ASTIN. Which report?

Senator SCHOEPPEL. Did the test report that you filed yesterday, as I understand, when you testified——

Dr. ASTIN. I didn't file a report yesterday. I offered to file a large report if the chairman so desired. This is the report that is being turned over to the National Academy Committee; I think that was the report I referred to.

Senator SCHOEPPEL. Then that came not as a result of the Federal Trade Commission's request or the Post Office Office's request?

Dr. ASTIN. No; this report I was referring to came largely as the result of the MIT report of last December.

Senator SCHOEPPEL. I see. I wanted to get that clear in the record.

Dr. ASTIN. Yes.

Senator SCHOEPPEL. On the few remaining questions that I have to ask you, Doctor, I want to make it crystal-clear that I support technical and scientific research; I believe in it.

Dr. ASTIN. I am aware of that, Senator.

Senator SCHOEPPEL. I believe it is a very necessary and important function that we have to provide for and to utilize to the fullest possible source. I realize that it has to be guarded, and it has to be administered in such a way that no injustices follow in the cases, and I do not know that you can ever prevent some. But, I make this preliminary remark because that happens to be my view, namely, that we have to have scientific research.

In this case here, we are trying to reach some final objective after all these proceedings have been finished, and whatever questions I have to ask are for the benefit of myself in trying to clear up some of the things I think ought to go into the record.

At the Post Office hearing on October 14, 1952, I believe you were asked about Mr. Ritchie's criticism of allowing the acid in the test batteries to go above 1.280.

Dr. ASTIN. Yes.

Senator SCHOEPPEL. If I remember correctly, you stated that this was not discussed until after the test was started; then Mr. Ritchie came around and asked the Bureau——

Dr. ASTIN. If I said that——

Senator SCHOEPPEL (continuing). To draw it off, and then add water.

In your testimony yesterday before the committee you testified that Mr. Ritchie had instructed on the acid being kept below 1.280

from the start, but that you did not do this because it would change the condition of the batteries being tested.

If that is the situation, and if I have quoted it correctly—and I have attempted to—Dr. Astin, how do you account for this discrepancy?

Dr. ASTIN. I don't remember specifically what is in the Post Office record, but the point I was trying to get over there is that it was not a matter of contention of rendering the test invalid until after the test started. The matter was mentioned by Mr. Ritchie in one of the first letters he wrote about the test, and, in my reply to him, I told him we would not make any changes in the acid density, and just a day or two before the tests started, in a verbal discussion in my office, we agreed to raise the limit to 1.325 instead of 1.280.

Senator SCHOEPPEL. Now, the verbal exchange was made between whom?

Dr. ASTIN. Mr. Ritchie was there, and I was there, and I think one or two members of my staff, Dr. Ramberg and, perhaps, Dr. Craig; I don't remember right now.

Senator SCHOEPPEL. Would that be covered in a written report in any way?

Dr. ASTIN. It is merely covered in an informal note in the record, but there were three items settled at that time about temperature and density, and the conditions for terminating the charging period. There were 3 items we discussed and reached agreement on; so that prior to the test we had settled on 1.325, and then the restoring, this argument of the restoring about 1.280 came up later, but we had——

Senator SCHOEPPEL. The Bureau of Standards' report on February 10 to the House committee—that was handled, I believe, by Mr. Wolverton—for the first time reported small but measurable harmful effects in Battery AD–X2.

Now the question I would like to ask is why did it take so long to find the small harmful effects?

Dr. ASTIN. Well, I explained that or attempted to explain that to Senator Ferguson this morning. The effects are so small that for, I think, all practical considerations they can be discarded or not considered.

Senator SPARKMAN. Disregarded.

Dr. ASTIN. Disregarded; thank you, sir. I think I also used the analogy that the effect is so small that if it were on the helpful side rather than the hindering side we would not consider it even then of sufficient importance to be considered as beneficial. I mean it would be trivial.

Our precision of measurement was gaged at measuring something—well, of course, the claims for this are that it would double the life of the battery—well, that is a substantial change in the performance characteristics of a battery. So we were looking for fairly large differences in the performance between batteries, and all of the standards of precision have been limited mainly by variations between individual batteries, and it was necessary to get batteries very nearly alike in order to find this effect at all; that is, if you got much spread in the quality of the batteries, it is impossible to determine in a controlled experiment a small effect, and this was uncovered by getting batteries of very close uniformity.

Senator SCHOEPPEL. One of the main questions, as I see it, in this entire case is whether the Bureau was completely objective and fair in the handling of AD–X2. Now, in your statement before this committee yesterday you said that the National Bureau of Standards published a pamphlet in 1931 known as Circular 302, and I hope I am not repetitious, but there are 2 or 3 angles of this I want to cover. In that pamphlet the Bureau found that none of the additives were effective in improving the performance of batteries.

Dr. ASTIN. Yes.

Senator SCHOEPPEL. You also admit that AD–X2 was not included in that pamphlet?

Dr. ASTIN. Yes, sir.

Senator SCHOEPPEL. We are clear on that, are we not?

Now in checking the testimony yesterday—and I have tried to read through pretty conscientiously the correspondence here between the Bureau of Standards and the National Better Business Bureau—in your statement you stated that the first you heard of AD–X2 or Protecto-Charge, as it was then known, was in April of 1948, when Dr. Randall wrote to Dr. George Vinal. I believe you also stated that Dr. Vinal deferred writing a reply to Dr. Randall.

Now in the letters between the Bureau of Standards and the Better Business Bureau, as shown here—I just want to point to two or three things: One, on January 25, 1948, Mr. Vinal of the Bureau of Standards wrote to the Better Business Bureau in response to the Better Business Bureau's letter of June 10, that year, 1948. The question I want to ask you is this: Why should the Bureau of Standards defer writing to Dr. Randall and apparently, according to the chronological sequence of events of the letters, reply promptly to the Better Business Bureau? I appreciate, Doctor, you were not in a command position over there, but I have wondered about that discrepancy in time.

Dr. ASTIN. Well, I think the difference—here, of course, I am conjecturing——

Senator SCHOEPPEL. Yes; I want to be absolutely fair to you. As I said, you were not in charge, in full command there, but that looked strange to me; there is some reason for it.

Dr. ASTIN. Dr. Randall's letter made no specific request for action, as nearly as I can recall. He was calling Dr. Vinal's attention to some things about a product that he believed to be true. Well, Dr. Vinal was skeptical about what he said or probably was skeptical about what was said in this letter, but since the letter called for no action, it seemed quite logical to defer a reply to it.

Now, as I recall, the National Better Business Bureau letter made a specific request for information or an opinion. I would guess that that is the reason why there was different treatment of the two.

Senator SCHOEPPEL. In the letter of June 25, 1948, Mr. Vinal writes, and I quote:

> I see no reason at the present time to change the statement made in our Letter Circular 302, but realize that the date of this circular is rather far back.

Now, Doctor, in view of Mr. Vinal's knowledge of AD–X2 through Dr. Randall's April letter, would you consider it objective to keep 302 in circulation without a test of AD–X2?

Dr. ASTIN. I think, from a strictly scientific point of view, there was no rational technical information supplied by Dr. Randall to Dr. Vi-

nal; that is, Dr. Randall was claiming that there was something unique in this particular combination of mixture of sodium and magnesium sulfate.

Subsequent investigations have shown that there was nothing unique about it. Dr. Vinal, on the basis of his long experience in this field, concluded that Dr. Randall was wrong.

Senator SCHOEPPEL. That is probably one of the reasons why, then, the letter from Dr. Vinal to the better business bureau on July 16, 1948, stated:

> I do not feel that I can take too much time to spend on these rather troublesome battery compounds. There seems to be unusual activity at the present time, which is probably the result of shortages of lead in finished batteries.

That to me, Doctor, would seem to indicate that the Bureau has looked beyond or past the objectivity in dealing with these additives. Of course, you have testified here that you had other later tests on these matters.

Dr. ASTIN. Dr. Vinal had a lot of heavy commitments on him at that time on what he considered much more important technical investigations, some for the Bureau of Aeronautics, some in connection with the Bureau's own measurement work, and this was a technical issue in which Dr. Randall's side had little technical merit, according to Dr. Vinal's estimate on it.

Well, to confirm that, it is my understanding that Dr. Randall attempted to write up some of this material he was telling Dr. Vinal about, and have it published in one of the journals of the American Chemical Society. The editors of the American Chemical Society rejected the publication as not having adequate technical content; and I think that that probably is quite a valid justification of the attitude Dr. Vinal took toward Dr. Randall's representations.

Senator SCHOEPPEL. Doctor, just about two more questions. They may be rather frivolous, but my good distinguished colleague from Florida went into the cost of the product that is somewhat in controversy here, as to its good or ill or bad effect. As to the costs of some of these, you testified a few cents to several dollars' worth. Well, I do not know whether the Bureau of Standards makes any definite tests on different types of eyewash that are going on the market or even aspirin.

Let us take a bottle of 100 tablets of aspirin, which is a very common compound. Have you ever run a test to see what the actual cost of the raw product that goes into it happens to be?

Dr. ASTIN. No; we have not, but I imagine there is a substantial difference between the retail price and the raw-materials price.

Senator SCHOEPPEL. Probably it would not be more out of line than that which was testified to here this morning about this product that goes into batteries, would it?

Dr. ASTIN. It might conceivably be of a similar order of magnitude; I don't know for sure.

Senator SCHOEPPEL. Thank you; that is all.

The CHAIRMAN. Doctor, before I turn to someone else, what happened to the batteries that were used for the Post Office test?

Dr. ASTIN. Do you mean the test that was specifically for the Post Office Department?

The CHAIRMAN. Yes, sir.

Dr. ASTIN. I don't know, sir.

The CHAIRMAN. You had about 14 batteries?

Dr. ASTIN. Yes, sir.

The CHAIRMAN. Were they stored or torn down?

Dr. ASTIN. I don't know.

The CHAIRMAN. You do not recall what happened to them?

Dr. ASTIN. No, sir; I don't. I can find out.

The CHAIRMAN. You mean when you had run the 2 weeks' test that was required you just——

Dr. ASTIN. There were six new batteries; I would guess they have been put into service somewhere.

The CHAIRMAN. The 16 were put in service?

Dr. ASTIN. No. In the Post Office test the figures you have been saying all day, and I think that my recollection of the Post Office figures is, there were 8 old batteries and 6 new ones. I would have guessed we must have used the six new batteries for some useful purpose, but I don't know.

The CHAIRMAN. You did not tear down the batteries that were used in the Post Office test?

Dr. ASTIN. No. To the best of my recollection——

The CHAIRMAN. How did you examine the plates if you did not tear them down?

Dr. ASTIN. The plates were not examined in those; these were checked only for electrical performance.

The CHAIRMAN. In other words, you did not check them to determine whether they had eaten the plates or any real effects upon the plates? You just took that from the standpoint of instrumental reading?

Dr. ASTIN. Yes, sir.

The CHAIRMAN. You did not check the solution that had gathered in the bottom—the sediment in the bottom of the battery?

Dr. ASTIN. Oh, yes; the sediment was measured, so the batteries must have been taken apart.

The CHAIRMAN. Because I did not think you could check that sediment unless you tore the battery down.

Dr. ASTIN. That is right. The sediment was checked.

The CHAIRMAN. On the Post Office batteries, whether they were new or old, you must have torn them down?

Dr. ASTIN. Yes, sir; that is correct.

The CHAIRMAN. But, those 16 that were used batteries, you think they are still around somewhere?

Dr. ASTIN. Oh, I know the 16 left over from the last June test are still around.

The CHAIRMAN. They are still around?

Dr. ASTIN. Yes, sir.

The CHAIRMAN. But the ones that you used on the Post Office——

Dr. ASTIN. I am not sure. Of course, the plates could still have been saved and the batteries used, even with opening them up for the sediment measurement.

The CHAIRMAN. Yes. Of course, you would have to reseal them.

Dr. ASTIN. They would have to be resealed; that is a simple operation.

The CHAIRMAN. I will turn to the gentlemen here. First, is Senator Sparkman.

Senator SPARKMAN. Doctor, you have been talking most of the time about these 16 batteries. I am a little confused. When did you use the 17 that we talked about yesterday, what test was that?

Dr. ASTIN. Seventeen?

Senator SPARKMAN. Or am I using the wrong figure?

The CHAIRMAN. You are using the wrong figure.

Senator SPARKMAN. There are 14, here, is that correct?

Dr. ASTIN. Yes.

The CHAIRMAN. We finally confirmed this—you have not been present at all of the testimony, but we finally got the figures proved that there were 25 batteries acquired.

Dr. ASTIN. Yes.

The CHAIRMAN. They found that there were only 16 of those that were in condition to use.

Dr. ASTIN. That is right.

The CHAIRMAN. And then on the Post Office test, which was an earlier test, you acquired 8 new batteries, and you used 6 used batteries, and all told 14?

Dr. ASTIN. The reverse.

The CHAIRMAN. I beg pardon?

Dr. ASTIN. Eight used and six new.

Senator SPARKMAN. Eight used and six new.

The CHAIRMAN. Eight used and six new; that was on what was termed as the Post Office test?

Dr. ASTIN. Correct, sir.

The CHAIRMAN. But you did later acquire 25; you rejected all but 16, and then proceeded to run the test on the 16 batteries?

Dr. ASTIN. That is right.

The CHAIRMAN. Senator Sparkman?

Senator SPARKMAN. Doctor, there are 1 or 2 things that I want to clear up for my own information and for the record, too. I realize that you have discussed this matter from the scientific viewpoint, and you have played down, if that is the correct word, the efficacy of testimonials from customers.

Now, I understand we are going to have engineers come before us who have been connected with various companies that have used this additive. Now, to what extent should weight be given to their testimony?

Dr. ASTIN. Well, I think you should ask them for the type of observations and measurements they have made on which to base their decision that the material helps them. You should ask them if they have any control so that they have a base with which to compare their measurements.

Senator SPARKMAN. Would their operations be of the nature that you have been talking about as field tests?

Dr. ASTIN. Well, they couldn't be construed as field tests unless there were adequate controls and adequate provision made for periodic measurements on the things, and I don't think they could be glorified to the status of being called a field test unless substantial care were made to make measurements on them during the progress of the use of the batteries.

Senator SPARKMAN. Well, the reason I asked that question—you realize that all of us on this committee are laymen.

Dr. ASTIN. Yes, sir.

Senator SPARKMAN. And I suppose the weight of lay testimony probably weighs more heavily with us than it does with one who is scientifically trained.

Doctor, how long have you been with the Bureau of Standards?

Dr. ASTIN. I have been there since 1930, and as a civil servant since 1932. I was a research associate for the first 2 years of my stay there.

Senator SPARKMAN. And where did you take your college work? I don't recall that you have put any of this in the record yet.

Dr. ASTIN. Senator Smathers asked me for that this morning.

The CHAIRMAN. That record has been made.

Senator SPARKMAN. Well, I won't ask you to duplicate it, then. I read your statement and I didn't see it in there, and I didn't recall that it had been queried about at all.

The CHAIRMAN. That was cleared up in this morning's testimony.

Senator SPARKMAN. Now, Doctor, again for the sake of completing the record, you testified this morning that the ingredients in this AD–X2 would have cost, I believe you estimated, about 5 cents. Is that all of them?

Dr. ASTIN. No.

Senator SPARKMAN. Or was that just one element?

Dr. ASTIN. That is for the sodium and magnesium sulfates, which are the primary materials.

Senator SPARKMAN. I thought it was made up entirely of that, with the exception of these trace elements.

Dr. ASTIN. Yes.

Senator SPARKMAN. I thought the trace elements were more or less accidental.

Dr. ASTIN. There are found in the ordinary grades of sodium and magnesium sulfates most of the trace elements found in this material. If, however, particular trace elements are put in, that is apt to be an added cost, but of probably trivial importance.

Senator SPARKMAN. The 5 cents, then, would represent in large part the contents of the package; is that right?

Dr. ASTIN. Yes, sir.

Senator SPARKMAN. Now, for the sake of the record, you, of course, did not intend that that represented the total cost to Mr. Ritchie?

Dr. ASTIN. Oh, by no means; no, sir.

Senator SPARKMAN. Because you don't know his labor and overhead, and all of those things that go into it.

Dr. ASTIN. No, sir.

Senator SPARKMAN. Did the Bureau of Standards make a qualitative analysis? In other words, did you state at one place in your testimony that the Bureau knew everything that was in this?

Dr. ASTIN. I believe that it is accurate to state that we have detected everything that is in this material in concentrations greater than five parts per million.

Senator SPARKMAN. Five parts per million?

Dr. ASTIN. That's right.

Senator SPARKMAN. Well, was there ever any discussion between the Bureau and Mr. Ritchie as to the makeup, the consistency of the ingredients, the formula?

Dr. ASTIN. Oh, I don't recall. The main thing that occurs to me right now is the material in Dr. Randall's early letters to Dr. Vinal in which he talked about it being a unique combination of these salts

of sodium and magnesium. There may have been other discussions. I don't recall them right now.

Senator SPARKMAN. You said five parts——

Dr. ASTIN. There was no discussion in the early correspondence about the importance of secret trace elements. I think we first heard about that a couple of years ago, but I am not sure on that score.

Senator SPARKMAN. I notice in Dr. Randall's first letter or second letter he referred to one of these elements as being slightly basic. Wasn't that the term used?

Dr. ASTIN. That is correct.

Senator SPARKMAN. What does that mean?

Dr. ASTIN. A basic material is the opposite of an acid material; that is, lye is an alkaline. It means if it were dissolved in water, it would react or have slight basic tendencies rather than acid tendencies.

Senator SPARKMAN. In other words, if there was a trace of lime, that would make it slightly basic; is that right?

Dr. ASTIN. Well, a trace of lime would; yes.

Senator SPARKMAN. If it were predominant?

Dr. ASTIN. I gather he was inferring that this property came from the material itself.

Senator SPARKMAN. Now, you used five points in a million. Is that pretty well the dividing line between what might be effective and ineffective?

Dr. ASTIN. Well, we are very doubtful that anything in concentrations that dilute could have any effect on the performance of these salts on the battery.

Senator SPARKMAN. Are you familiar with the statement in Dr. Vinal's book that iron, to the extent of three parts in a million, would make a battery inoperative in a very short time?

Dr. ASTIN. No; I am not.

Senator SPARKMAN. I believe that is all, Mr. Chairman.

The CHAIRMAN. Are there any other questions?

Senator HUNT. I have just 1 or 2.

The CHAIRMAN. All right; you may proceed, Senator Hunt.

Senator HUNT. Doctor, following up Senator Sparkman's reference, the question asking for enlightenment on what we should ask the engineers, in view of the fact that none of us are even chemists or scientists, do you have a checklist of questions that are completed when your examinations or your experiments on the batteries are completed? What kind of a form do they use in checking the various work that they do?

Dr. ASTIN. We don't have a standard form for presenting the data obtained from the tests, if that is what you mean; that is, the information that we are interested in mainly on these batteries is how much energy will they deliver, what percentage does this energy represent of the rated capacity of the battery. Those are the two most important things. And how much does the efficiency change with cycling.

Senator HUNT. Is there any textbook or any prepared information of any kind whereby those questions are set out with reference to a battery, that you know of?

Dr. ASTIN. Well, some of them in a bit different form would be included in Government purchase specifications.

Senator HUNT. I want to ask you another question, Doctor. Have you ever run into a situation similar to this in your 23 years of experience?

Dr. ASTIN. No, sir.

Senator HUNT. This is your first experience of this kind in 23 years with the Bureau?

Dr. ASTIN. This is a most unique experience, sir.

Senator HUNT. You spoke a few minutes ago of a report, National Academy report. Will you tell me what the National Academy is? Have there recently been new appointments to the National Academy, and, if so, who appointed them?

Dr. ASTIN. The National Academy of Sciences is a nongovernmental organization established through a Federal charter that was set up during the Civil War. Abraham Lincoln was one of the instigators in getting the National Academy set up.

It is composed of the leading scientists of the country. It is self-perpetuating. It is supposed to render scientific advice and assistance to the Government. That is one of its major functions.

It is, however, not to receive money from the Government for its general services. I think there are some types of things it does where it can be paid, but it is not a Federal agency; that is, it receives no appropriation. It is private, but it is, you might say, quasi-governmental, in that it has this Federal charter which gives it the specific responsibility for rendering aid to the Government.

Well, the membership of the National Academy includes the very top-level scientists in this country, and because of its charter responsibility for advising the Government, it is a very logical group to call on where there is a technical matter that needs settling.

Now, the president of the National Academy of Sciences was asked to set up a special committee to study this problem, to evaluate the adequacy of our work, the Bureau's work, and that committee was just set up last week.

Senator HUNT. And when is their report supposed to be ready?

Dr. ASTIN. Well, we don't know. It depends on a number of factors, whether or not they conclude field tests are necessary. I think it would be presumptuous of me to speak for the committee on this matter. That is their business.

They are going to investigate the efficiency of our work, and I would guess that it wouldn't take them very long to make a thorough appraisal of what we have done, but I have no idea as to how they are going about their job.

Senator HUNT. In assigning to them this new obligation or this new function, no time limit was placed; is that right?

Dr. ASTIN. No, sir; I don't believe there was.

Senator HUNT. Now, Doctor, do you care at this time to make a statement whether or not you will accept the report of the national academy on this particular problem as final? Will you agree with it, or can you say that in advance?

Dr. ASTIN. Well, I have great confidence in the group that is appointed, and I see no reason why I would not be able to accept their report.

Senator HUNT. And that should go for the proponents as well as the opponents in the present controversy?

Dr. ASTIN. Oh, I think so; yes.

Senator HUNT. That is all.

Senator SMATHERS. Mr. Chairman, I have 2 or 3 questions.

Doctor, this morning in response to a question you stated that you got into the chain of command, whatever that meant, about 1951. Is that your testimony?

Dr. ASTIN. That is correct. I was named Acting Director early in October of 1951, after Dr. Condon's resignation became effective, and then I was sworn in as Director on June 12, 1952.

Senator SMATHERS. Prior to your becoming the Director or the Acting Director, did you have any supervision over Dr. Vinal?

Dr. ASTIN. No, sir.

Senator SMATHERS. Did you in any way prepare any of the letters which he wrote?

Dr. ASTIN. Not the letters Dr. Vinal wrote; no, sir.

Senator SMATHERS. These letters in which he wrote to the better business bureau, the one, for example, of March 7, 1950, in which he asked for technical and legal advice, did you have anything to do with the preparation of that letter?

Dr. ASTIN. No, sir.

Senator SMATHERS. Did you know anything about that letter?

Dr. ASTIN. Not until I reviewed the files on the matter fairly recently.

Senator SMATHERS. In other words, it was not until the last month or two that you even knew that letter had been written?

Dr. ASTIN. Several months ago, within the past 5 or 6 months.

Senator SMATHERS. Since you have been the Director of the Bureau of Standards, have you written such a letter to the National Better Business Bureau, asking for legal or technical advice in any matter?

Dr. ASTIN. No, sir. I did have some correspondence with them last fall in response to their request about recent tests the Bureau had made.

Senator SMATHERS. Do you feel that it is proper in answer to a request from them to supply them with technical information?

Dr. ASTIN. I would construe that a responsibility of the organization.

Senator SMATHERS. I would like to read, just for the benefit of all of us, from the National Associations of the United States Department of Commerce book the definition of the better business bureaus; it lists the National Better Business Bureau:

> Better business bureaus represent self-government in local business. They are nonprofit service corporations maintained by business firms to elevate the standards of business conduct, to fight frauds, and to assist the public to achieve maximum satisfaction from its relations with businesses.
>
> They do not endorse or recommend any security, product, service or concern, and no concern is permitted to indicate otherwise in its advertising and selling. The two centers of information in this field at the national level are the Association of Better Businesses, which is in New York, and the National Better Business Bureau, which was established in 1911 and has from 30 to 35 people working for it.

Now, that organization being such as it is, in your opinion it has been all right since you have been the Director to supply them with only technical information?

Dr. ASTIN. Yes.

Senator SMATHERS. In response to some request which they have made of you?

Dr. ASTIN. Yes.

The CHAIRMAN. I think it would be only fair at this point, however, to recall that in all the evidence we have before us, we have not found any complaints from any of the agencies of the Better Business Bureau, have we, and we have not in our records any complaint from a user of a product?

Usually the Better Business Bureau will submit to governmental agencies, whether they be State or National, any complaint from a user or any inquiry from a user, and request information about the product. Then, and only then, does the Better Business Bureau try to ascertain whether the general public is being defrauded.

And what strikes me in this particular question is that we cannot and have not found any specific complaint from the users. And, Doctor, I would just like to ask you: Have you ever run up against a case where there were so many consumers who have used the product and where you have never found any specific charge or complaint from the users that the product is fraudulent and that they had been fraudulently sold the product? That is the strange part of this entire question to me.

Dr. ASTIN. Well, I haven't any basis for giving you the results of such a market analysis. We don't try to get into it, and I don't think I could answer that question. Also, I don't know what the experience of the National Better Business Bureau is in receiving complaints on this subject.

The only information we have on that, at least the only part of it that occurs to me right now, is the fact that the National Better Business Bureau told us that Pioneers, Inc., got in touch with the National Better Business Bureau asking for exemption for AD–X2 from statements they had been making about battery additives in the past; so it would appear that the initiative in this case was taken by Pioneers, Inc.

The CHAIRMAN. They asked to be exempted from Circular 302?

Dr. ASTIN. That is right; yes.

The CHAIRMAN. And 302 was based upon a finding which had been conducted about 18 years previous?

Dr. ASTIN. Yes.

The CHAIRMAN. And that was the basis on which Pioneers was begging that they be exempted from a general blanket statement that none of the additives were of any benefit; and that 302, referring to additives, was a circular that had been published many, many years previous. That was really what they asked to be exempted from, was it not?

Dr. ASTIN. That is out of my area, but exempting them specifically would have been equivalent to an endorsement wouldn't it?

The CHAIRMAN. Well, that is true, but what of including them?

Dr. ASTIN. They weren't included. Circular 302 was a factual statement about a basic material, sodium and magnesium sulfate. In that sense it should be as true 50 years from now as it was 20 years ago, when it was written.

The CHAIRMAN. Fifty years from now?

Dr. ASTIN. Yes, sir.

The CHAIRMAN. You are projecting yourself quite a long distance there, Doctor.

Dr. ASTIN. Let me explain this. By that statement I don't mean at all that there won't be improvements in batteries during that time,

but the fact is this: That in a battery consisting of lead and lead peroxide plates, sulfuric acid is the electrolic, and sodium and magnesium sulfates have no measurable effect. That is a fact. If it was a fact 30 years ago, it is a fact now, and it will still be a fact 50 years from now.

The CHAIRMAN. You would not discount the possibilities that they might find some other rare elements?

Dr. ASTIN. Oh, no.

The CHAIRMAN. Or that they could inject them into the batteries which would be beneficial?

Dr. ASTIN. No; I am not discounting those.

The CHAIRMAN. I am sorry; I will turn the questioning back to Senator Smathers.

Dr. ASTIN. I think that is a very important point, however, Mr. Chairman. Our attitude on all of this is the presentation of scientific facts, and if the boundary conditions on facts are actually enough defined, they are permanent. But that is not discounting progress, not by any means.

The CHAIRMAN. No, sir; because we have seen progress in the last decade.

Dr. ASTIN. Oh, tremendous.

The CHAIRMAN. Scientists, even when you were in school, would have said some of it was impossible; isn't that true?

Dr. ASTIN. Well, lots of things have been accomplished that we didn't dream about many years ago, there is no question about that.

The CHAIRMAN. Exactly, sir. Senator Smathers.

Senator SMATHERS. Doctor, the point I want to make is this. Since the time that you have been director of the National Bureau of Standards, is it not a fact that you have authorized no investigation of this product, and I assume any similar product, unless it had been requested by the Post Office Department or the Federal Trade Commission?

Dr. ASTIN. No, sir; that is not quite true. There were these two investigations for the Post Office and Federal Trade that occurred somewhat over a year ago. Then there was this investigation of June 1952, which was initiated primarily, I think, to satisfy the interest of Members of the Congress, and also to try and settle the matter.

Senator SMATHERS. To recheck your previous findings?

Dr. ASTIN. To attempt to settle the matter; and then there was a further series of tests which we started this past decade, so there are four groups of tests on this material which have been authorized under my jurisdiction.

Senator SMATHERS. The tests which have been started—the one of the past December resulted, did it not, in trying to satisfy officials in the Congress, Senators, and people who had inquired about it, this Small Business Committee and others, that the results which you had previously gotten from earlier tests were the same and that you had done it correctly the first time?

Dr. ASTIN. That is it; yes, sir.

Senator SMATHERS. And you say that since you have been director, you have not sent any letters to the Better Business Bureau of the nature which Dr. Vinal sent in 1950?

Dr. ASTIN. That is correct.

Senator SMATHERS. Now how old a man is Dr. Vinal?

Dr. ASTIN. I believe he turned 70 last December. He retired as he was approaching his 68th birthday.

Senator SMATHERS. And how long had he been with the Bureau of Standards?

Dr. ASTIN. Approximately 43 years.

Senator SMATHERS. Had any complaint that you know of been made about him during that time of 43 years?

Dr. ASTIN. He was considered one of the most esteemed and valuable members of the organization.

Senator SMATHERS. Do you think that, having retired and having this experience as an electrician and a battery expert, he should have gone to work for a dairy, for example, or a cement-mixing plant, or do you think it is logical that he went to work for a battery concern?

Dr. ASTIN. I think it is a very logical thing to have happened.

Senator SMATHERS. And as I understand it from previous testimony that you made, he is only a consultant now for possibly 1 or 2 hours, was it, a day or a week?

Dr. ASTIN. I really don't know on that, sir. It is my understanding—and this is second- or third-hand—that it is approximately 2 days a week.

Senator SMATHERS. One other question and then I will stop. Concerning the appearance which you made before the Post Office Department, which, apparently, was the basis for the subsequent fraud order, have you not testified that you appeared there at the request of the Post Office officials?

Dr. ASTIN. That's right.

Senator SMATHERS. At the time that you appeared and gave them the results of your test, did you make any recommendation as to whether or not a fraud order should be entered or not entered?

Dr. ASTIN. I don't believe I did. I have no recollection of so doing.

Senator SMATHERS. As a matter of fact, you testified this morning you knew that you didn't.

Dr. ASTIN. It is inappropriate for us to do it. I have no opinion on that now. The determination of fraud is out of our area of competence.

Senator SMATHERS. So it was something outside your jurisdiction?

Dr. ASTIN. That is correct.

Senator SMATHERS. You testified this morning you knew that you didn't. I presume that had you made such a recommendation, it would have been in the record and already been out here in evidence before the committee.

Dr. ASTIN. Yes, sir.

Senator SMATHERS. Now, just as one last question, prompted by my good friend, the Senator from Kansas, about the relative worth of the product aspirin as compared to the relative worth of AD–X2, in your offhand opinion do you think that the value of aspirin has been proved and established more so than the value of AD–X2?

Dr. ASTIN. I buy aspirin.

Senator SMATHERS. No further questions.

Senator SPARKMAN. In considerable quantity?

Senator HUNT. Lately?

The CHAIRMAN. Doctor, I hope we weren't the cause of you buying any.

Dr. ASTIN. I have got a great big 85-grain tablet that I keep in my desk. It is National Bureau of Standards size.

The CHAIRMAN. Doctor, in order to clarify the record, or rather the statement that you made yesterday, on page 15 of your statement yesterday you stated:

> The Bureau has not resorted to field tests with battery additives because it has not been possible to find in the laboratory any effects which are related to the normal use of lead-acid batteries.

Would you include the eight effects as found by the MIT and later confirmed by the Bureau in the above statement?

Dr. ASTIN. The one important effect from our point of view, at least the one that had solid technical backing to it in their report, was their first conclusion about the charge and discharge cycle.

Those were obtained, as I explained, at very dilute acid concentrations, and that acid concentrations and with charging times so short that I am sure the batteries would not have had enough energy in them to start an automobile battery, and for that reason we considered the data establishing that conclusion were not in line with normal operating characteristics.

Now there were some other conclusions later on in the report, I don't remember the number, about sedimentation, which we felt were not backed up with adequate data, and which were definitely contrary to our data.

The CHAIRMAN. But it was a question that two scientists differed on?

Dr. ASTIN. That was a question where there was a difference; yes, sir.

The CHAIRMAN. Where there was a difference between two very eminent scientists. There is no question about it.

At the bottom of page 17 and the top of page 18 of your statement you stated:

> From 1931 to the start of World War II, nine other battery additive materials were investigated either for the FTC, the Post Office Department or Members of Congress.

Dr. Astin, why did you use the term "investigated"? Did you actually test these nine additives? What do you mean by "investigate"? We want to be sure that your record is clear and understandable on that point.

Dr. ASTIN. They were subjected to some sort of laboratory test, either to chemical analysis or to actual tests in the battery.

Now there have been so many of these sodium and magnesium sulfate mixtures that I think in some instances reports were made that this is another sodium and magnesium sulfate mixture, and the report would then be just one of chemical analysis. The chemical analysis was usually done first.

The CHAIRMAN. But that would be just the laboratory investigation rather than an endeavor to do a more extensive test on it.

Dr. ASTIN. By the word "investigation," here I mean a laboratory study.

The CHAIRMAN. That is what you meant by that?

Dr. ASTIN. Yes, sir.

The CHAIRMAN. That is what I wanted to find out.

Dr. ASTIN. Yes, sir.

The CHAIRMAN. Then on page 18 of your statement you stated:

In response to a continuing demand for information from the public about battery additives, Letter Circular 302 was reissued in 1949 with only minor variations from its original form.

Dr. ASTIN. Yes.

The CHAIRMAN. Dr. Astin, for the sake of the record, did you have a public demand for a new Letter Circular 302, from anyone in addition to the National Better Business Bureau, whose letters pressuring you for a new Letter Circular 302 are right before me? If it was only the Better Business Bureau, don't you think it is distorting things to imply that there was a widespread demand from the general public?

Dr. ASTIN. If that is true, it would not be an accurate statement. I can if you wish check as to the reason, more specific reasons, for the reissuance of 302.

The CHAIRMAN. I would like the record to show specifically what the pressure was.

Dr. ASTIN. Very good, sir.

(In compliance with the chairman's request, Dr. Astin subsequently supplied the following information in letter of June 29, 1953, to the chairman:)

Specific information on the demand for the reissuance of this circular is not available since records are not maintained in connection with such requests. It should be noted that the Bureau receives tens of thousands of inquiries per year for technical information of various sorts and requests for information on battery additives would fall in this category. Generally, such requests as can be answered by the enclosure of a leaflet are handled by writing a note on the incoming letter and returning it to the sender with pertinent enclosures. Records of these inquiries are not maintained. In those cases where the incoming letter is retained, current practice is to destroy the letters at the end of 2 years since such items are considered of temporary value. Consequently, no records are available to supply the basis for answering the question about the demand for the reissuance of Letter Circular 302. Furthermore, the individuals who would have been directly involved with such requests are no longer with the Bureau. The records merely show that the old circular was reissued on March 21, 1949, because the supply of copies of the circular was exhausted and the old stencil was not reusable.

The CHAIRMAN. On page 19 of your statement you stated, and I quote:

In these comments, Dr. Vinal attempted to point out to Dr. Randall where some of his claims were not in accordance with the accepted theory and in which Dr. Randall indicated that the statements made in the Bureau's Letter Circular 302 were true for all other additives but not for AD–X2.

To clarify the record, Dr. Astin, when you refer to, and I quote, "accepted theories," to what do you refer? Is that the Bureau of Standards' theory?

Dr. ASTIN. No, sir. I would say it would be modern theories of the electrochemical processes in batteries, and again I make reference to the fact that Dr. Randall's views on this were sufficiently different so that the paper he proposed to write about this was rejected by the American Chemical Society.

The CHAIRMAN. I won't dispute that in any sense because I am not a chemist, but nevertheless he was a recognized scientist, and he was supposed to know something about it, isn't that true?

Dr. ASTIN. He had a very wide reputation, was very well known. His reputation came to him, I believe, mainly because he was the junior author of one of the classical textbooks on thermodynamics.

The CHAIRMAN. Again I know nothing more than when we started. On page 20 of your statement you quoted a letter from Dr. Condon to Senator Knowland where Dr. Condon pointed out the tests of AD–X2 were being made by Signal Corps laboratories and by the New York and Mare Island Navy Yards, and that, therefore, the Bureau of Standards didn't have to make the test.

Dr. Astin, do you mean to say that the Bureau accepted the work of such laboratories and on the basis of such report came to the conclusion concerning battery additives?

Dr. ASTIN. No, sir. That may require some explanation. You see, the requests were made that somebody, or suggestions that somebody ought to test it and see if it is in fact different from the other sodium and magnesium sulfate mixtures, and since another Government laboratory was doing it, we saw no reason for it.

The CHAIRMAN. And then we find, Doctor, that on page 23 of your statement yesterday you stated:

> Every action which the Bureau has taken with respect to the testing of AD–X2 and the dissemination of information with respect thereto has been brought about as a direct consequence of the representation and pressure of the proponents of AD–X2.

Now, Dr. Astin, in view of the voluminous correspondence between the Bureau of Standards and the National Better Business Bureau, and in view of Mr. Brode's testimony before another committee which was read to you yesterday, do you not think that the action of the Bureau was in fact guided by other pressures?

Dr. ASTIN. Well, I feel fairly certain that the interests and actions of the National Better Business Bureau in this were brought about by representations made to it by Pioneers, Inc., so that if we supplied information for the material at the request of the National Better Business Bureau, it in turn was instigated, I believe, by Pioneers, Inc.

The CHAIRMAN. Pioneers, Inc., was in the field selling.

Dr. ASTIN. No, it is my understanding that they wrote to the National Better Business Bureau saying they should be exempted from claims which it had been making about battery additives.

The CHAIRMAN. You think that, if a man came into the field at a later time thinking in all sincerity that he had something that was beneficial to extending the life of a battery, he should not be condemned by something that had long previously been issued as an official circular by one of the highest Government agencies we have that condemns the product as then known in the field of additives?

Dr. ASTIN. The Circular 302 presented conclusions from technical data. The proponents objected to what was in there. Well, they could either let it lie and try to run their business without it, or they could try and get some sort of either endorsement or exception. They chose to try the latter course and they encountered resistance when they attempted to get exceptions, because exceptions would have been equivalent to endorsement.

The CHAIRMAN. Of course, if there was a wide publication of the circular, that in itself would have the effect of condemning the product. Wasn't that the question that the manufacturer might have had in mind, that he was being condemned without having had any official

test, and he felt that he had been able to add the various chemical compounds together so that it did have an effect on neutralizing the sulfation within a battery that had a tendency to destroy a battery or to render it useless, and also to break up the sedimentation that collects in the battery, which has the effect of shorting a battery?

You see in the event that there is anything that falls off the plate that can gather into a crystal or a form which has the effect of shorting a battery, once a battery is shorted that battery is useless; but if this product is able to dissolve those particles so that they cannot short the battery, then the battery does have a usefulness.

Now those are factors that as just ordinary laymen we must take into consideration, because those who have spent this money buying and rebuying can't be all fools, Doctor. Something has happened here extending the life of the batteries of a fleet operator, or otherwise he wouldn't have spent the money. Now, that is what I have to examine.

Not being technically qualified to examine it as you do, I have to take the commonsense approach to it. Now, is there any just reason for me as an ordinary layman to examine the whole question in this manner? Suppose it were you or I in business and we had customers who hadn't complained, and then all of a sudden a governmental agency steps in and says, "You haven't got anything; you are just simply selling something here that doesn't mean a thing in the life of the battery," but at the same time we find over here a great number who have used it, seem to be satisfied and think they have something. Incidentally, I have heard men say, "The battery in my car was absolutely dead. I couldn't get my car started, and I expected to trade in the battery, and I put that fool stuff in the battery and they shoved the car and I got it started, and because I drove the car and got that generation into the battery I haven't had a bit of trouble since. I don't know what is in it, but that is what it did to my battery, and I haven't had any trouble for 30 days."

Now, if they tell me that, that is just something that I can't disregard. I have to look at it with the query: Is there something in it here that the chemists haven't found in their laboratory study of its effect on the plate? Now, that is the whole simple question that I am torn with as a man that sits here at the head of this committee and the man who is appealed to on this committee for some assisance.

Dr. ASTIN. I think Abraham Lincoln made, or, at least, there is attributed to him, a famous statement which is pertinent:

> You can fool some of the people all of the time, all of the people some of the time, but you can't fool all of the people all of the time.

The CHAIRMAN. But there is a shrewd, hard-fisted businessman who has a fleet of motors and uses a great number of batteries and you have fooled him for a period of 5 years. Now, that doesn't hold with Lincoln's statement, you see, because they have been successful in fooling him for 5 consecutive years.

Dr. ASTIN. The Lincoln statement says, "You can fool some of the people all of the time."

The CHAIRMAN. But in that "some" there was quite a number, won't you agree?

Dr. ASTIN. There seems to be quite a number of people as far as I have been able to make out who feel they get benefit from this product.

The CHAIRMAN. You say they do feel that?

Dr. ASTIN. I have no contact or direct information from them. I have merely read Mr. Ritchie's testimonial letters, and, judging from those, there are a number of people who like the product.

The CHAIRMAN. But, Doctor, about the man whose battery was dead in his car, wouldn't turn his motor over, and who, knowing that his battery was weak and wouldn't hold a charge for any length of time, used the compound and apparently found the battery no longer performed in that same weak manner; would you say that he was being fooled, or what?

Dr. ASTIN. I think the man is being fooled; yes, sir. I sincerely believe that, Mr. Chairman.

The CHAIRMAN. I couldn't press that any further.

Dr. ASTIN. And I think this really is a technical question, that is, the material either affects the performance of a lead-acid storage battery or it doesn't. If it affects the performance of the battery, it does something to it that can be measured. Now scientists can settle this question, and I am sure that the National Academy——

The CHAIRMAN. I am sure of that too, but in the meantime if this becomes a prolonged investigation, the manufacturer in question might well be out of business and long since liquidated by bankruptcy action.

Dr. ASTIN. Relative to that I am not a market analyst, Mr. Chairman, but from my layman's point of view on that subject, I would think that if there are all these satisfied users of the product, they will go on buying it, regardless.

The CHAIRMAN. Well, Doctor, that is the only reason in the world, having the responsibility of this chairmanship, that I would subject myself to the unpleasantness, because I had never met you until I shook hands with you here the other day, and the last thing in the world that I want to do is to embarrass you, Doctor.

Dr. ASTIN. Thank you, sir.

The CHAIRMAN. As man to man, the last thing in the world that I would want to do would be to embarrass you, because personally I could accept you as one whom I would like to have as a friend, and that is my sincere inner feeling at this time. Therefore, I am not asking questions to embarrass either you or the Bureau of Standards, but I am thinking that, if the test that is now being instigated, were to continue for a year or more in a field test, and with a fraudulent order that was issued—even though it was retracted and held in abeyance for a period of time—it has the effect of absolutely beclouding the manufacturer as not only a name but beclouding him in his manufacturing, and if that is the case, he might well be liquidated before the final test has been run.

That was what brought me to the decision that in all fairness to everyone concerned, we should get into this question here and try to get all the facts as best we could. I realize, as a committee chairman, that it has all the problems that any man could possibly be faced with, because it embarrasses you, the Bureau of Standards, it embarrasses the committee and Members of Congress.

Now I hope that we can cast that vote and come back. There are two gentlemen from California whom I would like to hear this afternoon to accommodate them and permit them to leave again. As far as I am concerned, Doctor, this concludes the questions that we would

care to ask of you. I thank you for the time that you have given us, and I deeply appreciate your frankness. You have endeavored, I know, to cooperate with us.

Senator SPARKMAN. Mr. Chairman, I was just thinking I believe there are about three amendments over there to be voted on and it is possible that we will be tied up, but we could call back in a short time.

The CHAIRMAN. All right. Tomorrow morning we will resume at 10 o'clock and we will be in room 457 in this building. If the witnesses from California will wait, we will call back just as soon as we find out what is going to take place on the Senate floor. But, we are through with you, Doctor.

Dr. ASTIN. I would like to thank you very much for your courtesy. I would like to volunteer to appear again later if anything develops where you think I might be useful.

The CHAIRMAN. That we thank you for, Doctor, and we will call on you if it develops that anyone would like an opportunity to question you.

(There was a short recess.)

The CHAIRMAN. Will the committee come to order, please? We do not know when the next quorum bell is going to ring, because they are on a bill and it may be in 10, 15, or 20 minutes, or it may not be for 2 hours. None of us knows, but we will resume in order that we may try to accommodate the two gentlemen here from California.

Mr. Cunningham will be the first witness. Will you take the chair please, Mr. Cunningham? Mr. Cunningham, will you stand up and raise your right hand? Do you swear that the testimony you are about to give pertaining to the matter now before this committee is the truth, the whole truth, and nothing but the truth, so help you God?

Mr. CUNNINGHAM. I do.

The CHAIRMAN. Mr. Cunningham, state for the reporter and the record your full name.

TESTIMONY OF ERWIN GEORGE CUNNINGHAM, CHIEF, PLANNING AND SURVEY SECTION, UNITED STATES ARMY, TRANSPORTATION CORPS, FORT MASON, SAN FRANCISCO, CALIF.

Mr. CUNNINGHAM. Erwin George Cunningham.

The CHAIRMAN. And whom do you represent?

Mr. CUNNINGHAM. I am a private citizen. In no way should it be construed that I appear as a representative of the Government.

The CHAIRMAN. But you are a private citizen?

Mr. CUNNINGHAM. Yes.

The CHAIRMAN. And for whom do you work?

Mr. CUNNINGHAM. The United States Army, Transportation Corps.

The CHAIRMAN. You work for the United States Army in the Transportation Corps?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. And what are your duties there?

Mr. CUNNINGHAM. At present I am Chief of the Planning and Survey Section of the Rio Vista Marine Storage Activity, Engineering Branch.

The CHAIRMAN. Now what do you mean by Marine Storage?

Mr. CUNNINGHAM. We deal with vessels, barges, derricks, all different types of gas, diesels, steam engines for the Transportation Corps.

The CHAIRMAN. Well, then will you proceed to tell us what you wish to tell us? You are employed by the United States Government?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. And how long have you been employed by the United States Government?

Mr. CUNNINGHAM. Since approximately 1943.

The CHAIRMAN. 1943?

Mr. CUNNINGHAM. Approximately; yes, sir.

The CHAIRMAN. How long have you been employed in the same division in which you are now working?

Mr. CUNNINGHAM. From about 1944 through 1949, I was port engineer in a different position. It was the small-craft section.

The CHAIRMAN. In the small craft section?

Mr. CUNNINGHAM. Yes, sir. This Rio Vista Marine Storage Activity is something that has just been organized in, possibly, the last 3 or 4 months. It is still part of the Transportation Corps, though.

The CHAIRMAN. And you are supervisor, or do you do manual labor?

Mr. CUNNINGHAM. I am a supervisor.

The CHAIRMAN. Well, then you may proceed to tell us what you wish to tell us.

Mr. CUNNINGHAM. What I have to say is from the practical standpoint of the use of this product out in the field. I would like to have this understood: The use of this material in no way should be construed as a controlled or uncontrolled test, and there is no scientific data with it. It is just a plain material such as you, sir, or the members of your committee would use in your ordinary battery. We used the material in accordance with the——

The CHAIRMAN. Were you the person who made the decision to buy the product?

Mr. CUNNINGHAM. No, sir. That goes through regular channels. When you require something——

The CHAIRMAN. Did you make a recommendation to regular channels or did they furnish it to you with instructions to use it?

Mr. CUNNINGHAM. No, sir. We requisitioned it through channels, then we contacted the manufacturer as to the proper use of his material. I had witnessed use of it before, and was aware of it and saw very good results from it.

The CHAIRMAN. When did you first have the opportunity to witness the product?

Mr. CUNNINGHAM. Possibly in the end of 1948.

The CHAIRMAN. And what kind of equipment had you witnessed it used in?

Mr. CUNNINGHAM. Different types of automotive batteries.

The CHAIRMAN. Like batteries in trucks?

Mr. CUNNINGHAM. In trucks, automobiles, radio cars, fire engines, trucks, marine batteries, heavy duty type, all different types of batteries.

The CHAIRMAN. Marine batteries, the type of batteries used in tugboats?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. Or submarines?

Mr. CUNNINGHAM. No, sir; no submarines.

The CHAIRMAN. Just tugboats?

Mr. CUNNINGHAM. Just tugboats.

The CHAIRMAN. And who owned the tugboats?

Mr. CUNNINGHAM. The United States Army.

The CHAIRMAN. The United States Army, and they were used around the harbor?

Mr. CUNNINGHAM. The first time I became aware of this product, as far as I know the Government had not used it in any of their tugboats, small freighters or anything of that nature. I did understand it was used at an arsenal in different types of automotive-type batteries.

The CHAIRMAN. Now then, will you go ahead and tell us just exactly what your qualifications are to determine why you thought there was some benefit to be derived from the compound?

Mr. CUNNINGHAM. Well, I am a licensed marine engineer, licensed by the United States Coast Guard. Part of your examination deals with batteries, and you have to be more or less a jack-of-all-trades to be a marine engineer.

By that I mean you have a lot of different type equipment to take care of, and it is up to you to maintain it to the best of your ability with what you have aboard the vessel.

When we first used this material, we had used the normal testing equipment such as you would find in a battery shop or a gas station or a garage, which consists of a voltmeter, a hydrometer. Most hydrometers have a thermometer on them to gage the temperature of the electrolyte so that it doesn't exceed say 110 or 115. The reason for a thermometer is that you get variations in readings.

Eighty degrees Fahrenheit is the general standard that most battery manufacturers work from. If you have too hot a battery, you will get a different reading than you would if you had a cold battery. We had tested 158 batteries aboard 12 different vessels on our first test, and there were very few of them that were mechanically unsound.

By "mechanically unsound" I mean when we put a voltmeter on them first we tried an open circuit test on them and they all read around 2.1, which is generally standard. Then we put a load test on them either with a sun test which is an improved test, putting on a 300 or 600 amp load which would be similar to when you start your automobile engine with your starter. If the person who tested it wasn't available, we disconnected the fuel racks and used the pieces of equipments' own starters and then checked voltages at the same time. That determines whether the battery is mechanically sound. Finding out that a battery is mechanically sound, then we charged them at a very slow rate not to overheat them or overcharge them.

After 24 to 48 hours, you take your readings. Then you try to take a reading every hour for over a period of 3 hours. If you don't have a rise in specific gravity, you generally take it that that battery has been charged as much as it possibly can without burning it up.

Then we added this AD–X2 in the battery and took readings over a period of maybe 3 or 4 weeks apart from the time it was first treated, and in most cases the specific gravity came up to the manufacturer's specifications.

Now, on our heavy duty marine type batteries, they are anywhere from three to four hundred, four hundred eighty amp power capacity batteries, very, very heavy duty batteries, and the specific gravity

reading is quite low on this type battery; it generally averages 1.220 compared to an automobile battery of 1.280. The reason, I imagine, is—I have been taught this is to eliminate or try to eliminate sulfation of the battery.

Now, most of our batteries, when we had checked them were very low in specific gravity, which has a tendency to show that they were sulfated. We have several complaints from chief engineers and operators that they were having battery trouble.

At that time batteries were very hard to get hold of; and sometimes, when you do requisition a battery it is possible those batteries you are going to get might be in as bad condition as what you are pulling off the ship, because they might have been on a shelf for quite some time in a stockpile, and would be shelf-sulfated. At other times if there were no batteries available at a stockpile, they could be purchased locally.

At other times we would get batteries in a dry-charge state, and they send the electrolyte with them, which very seldom had any sulfation. Then over a period of up until January 1951, we had no known failures out of the 158 batteries.

The CHAIRMAN. You mean the 158 batteries that you had first tested and you found the battery to be weak; or were they normal batteries when you first tested them?

Mr. CUNNINGHAM. The batteries that we had treated averaged 3 to 4½ years in age.

The CHAIRMAN. At the time you treated them?

Mr. CUNNINGHAM. At the time we treated them, three to four-and-a-half years in age. Now I want you to bear in mind that a marine-type battery is a very heavy-duty battery in its construction.

The CHAIRMAN. What is the life expectancy?

Mr. CUNNINGHAM. We had that question asked of us approximately a year ago. We contacted quite a few different battery manufacturers and they gave us what we call weasel talk. You go right around in a circle and you end up no place.

It depends on the type of construction of the battery, whether it is hard rubber case, wood case, wood separator, rubber separator, glass fibers, or what it is. We couldn't get a concrete answer from them.

They would tell you it would be guaranteed anywhere from 12 months up to 5 years at a pro rata guaranty. Now the pro rata, as everybody knows, you pay so much for the used portion of what you have used of the battery.

The CHAIRMAN. But normally that same battery would be good for 12 months up to—what was the maximum?

Mr. CUNNINGHAM. Five years.

The CHAIRMAN. Up to 5 years.

Mr. CUNNINGHAM. That was on certain types of batteries.

The CHAIRMAN. What was the guaranty type of the battery?

Mr. CUNNINGHAM. There is another thing——

The CHAIRMAN. I realize the exceptions that they make, and they are the sole judge of whether the exceptions shall hold or shall not hold, but what I am getting at is that under normal conditions what is the maximum life of that heavy duty battery if all things that they say must not be done are adhered to; then what is the maximum?

Mr. CUNNINGHAM. We did pin them down to a 12-month guaranty.

The CHAIRMAN. But they could last up to 5 years?

Mr. CUNNINGHAM. Up to 5 years.

The CHAIRMAN. Under all favorable conditions?

Mr. CUNNINGHAM. Under very favorable conditions.

The CHAIRMAN. And you added the additive and what was the result?

Mr. CUNNINGHAM. We broke it down in percentage. In the American Association of Battery Manufacturers they give you a kind of reference guide to go by in accordance with the specific gravity rating of a battery. For instance, a 6-volt automotive-type battery, when it registers 1.280 is considered fully charged and capable of delivering 100 percent of its electricity. Then, it breaks it on down the line and you get to about 1.160. At that point they figure the battery is nil. In other words, it is beyond use.

It has no more electrical carrying capacity. So, basing those figures, we arrived at what we thought would be the life expectancy of those 158 batteries, and they varied. I broke those down into quite a few figures.

The CHAIRMAN. What was the life expectancy as you had figured it?

Mr. CUNNINGHAM. Well, they varied. It depends upon the specific gravity rating at the time. Now, of the 158 batteries, the way we had figured it, 43 percent had zero life expectancy. I take that back; 43 of the 158 or approximately 27 percent. Thirty-four had 6 months' life expectancy, 54 had 1 year, and 27 of the 158 had a year and half life expectancy, basing that on using the specific gravity as a guide.

The CHAIRMAN. And then what did you find the situation to be after you added the AD–X2?

Mr. CUNNINGHAM. Well, in all cases the specific gravity reading came up to manufacturer's specifications. The batteries—I have quite a few comments from operators and chief engineers that were assigned to the respective vessels. Some of them were very dubious about it.

They were died-in-the-wool oldtime chief engineers and they had used battery additives in years gone by. They did admit that the specific gravity reading came up and the batteries appeared to gas less and use less water and took less time to charge, but they still wanted a longer time to see whether this was just a pep-up for a month or two, which was their privilege at the time. But it turned out in January of 1951 we took another check and on some of the vessels that had been declared excess the batteries were removed and stored in the battery shop. We found out that those batteries were in serviceable condition ready to put back into operation if needed.

The CHAIRMAN. And that was what, a year later?

Mr. CUNNINGHAM. That was January of 1951.

The CHAIRMAN. And when did you put the AD–X2 in?

Mr. CUNNINGHAM. The AD–X2 was installed in the batteries—the batteries were treated in March and April of 1949. That was approximately 2 years later. Then by September of 1952, we had 44 failures, battery failures.

Now, whether it was sulfation, mechanical, or what, I do not know, because we performed no tests and did not break the batteries down to determine what caused it. There are several other causes.

One vessel was in a shipyard for voyage repairs. The skipper complained of dead batteries and we removed 2 of the 14 batteries at random, delivered them to a large battery manufacturer in the city,

asked them to test the batteries and he put them on a charge, I think it was, for approximately 48 hours.

At the end of 48 hours the batteries didn't respond, so we opened them up, several of the cells, at random, and the report we got—now, I don't recall whether it was in writing but I do know I talked personally with the gentleman and I got it verbally first off the phone—that the positive and negative plates were heavily sulfated.

In some cases the separators were cracked, so we told them to assemble the batteries again and we would pick them up, and we brought them back to the shipyard and issued a change order, what we call a field order, to have those 14 batteries serviced by the AD–X2 method. I remember, right at that time it cost about $10 a battery to service them.

The batteries were serviced, put back aboard the vessel and they all came up to the specific gravity, as recommended by the manufacturer, and produced their normal load.

The CHAIRMAN. What do those batteries cost, new?

Mr. CUNNINGHAM. I don't recall, but in most cases it would be in excess of $100.

The CHAIRMAN. $100 and a $10 service cost in the application of the AD–X2?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. And those batteries you claim returned to a serviceable state?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. And that was what month and what year?

Mr. CUNNINGHAM. That was in May of 1949.

The CHAIRMAN. May of 1949?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. And where are they now?

Mr. CUNNINGHAM. Now, there is something I do not have records of. In the latter part of 1949 I had been bumped out of my port engineer's job and went back as a chief engineer. I held seniority as that and I was out in the field as an engineer for approximately a year to a year and a half. Then I came back up in the office again, so I do not know what happened to those batteries. I have no record, whatsoever, of them.

Another case was on a small freighter that had 24 batteries on it. The vessel had just been returned from overseas, and evidently had been laying there for quite some time. The batteries were in a very deplorable condition. They had never been attended to because the vessel just laid at a dock.

During the course of the voyage repair, we had these batteries serviced with AD–X2, but serviced right aboard the vessel. On the other vessel we had taken the 14 batteries and delivered them to the AD–X2 shops. But, on this one particular vessel where we had the 24, we had the contractor who was doing the voyage repair, service them, service the batteries, who subcontracted out to an electrical company who had Pioneers, Inc., supervise the servicing of the 24 batteries.

Now those batteries all came back to the recommended manufacturer's specification as far as specific gravity and the load test were concerned, and two of our inspectors signed them off as being O. K.

The CHAIRMAN. With those batteries they went right back to sea?

Mr. CUNNINGHAM. This particular vessel had come in for voyage

repair and was going up to what we call wet storage. At a later date we had been ordered to remove batteries from wet storage in active craft and what happened to those batteries, I have no record of. Most of our records, of course, are all on active craft such as in the harbor use where we have a crew aboard.

That crew, of course, is issued SOP's on the proper maintenance of all equipment aboard a vessel, particularly batteries which they generally take a specific gravity reading of once a week and add distilled water if necessary. So, they do have a pretty good control of active craft. But, the inactive craft, when they go up to the wet storage and the batteries are removed, we don't have any control of.

The CHAIRMAN. You want to proceed with your statement or would you rather have questions asked of you?

Mr. CUNNINGHAM. It makes no difference, sir.

The CHAIRMAN. Senator Sparkman, do you wish to ask some questions?

Senator SPARKMAN. If I understand correctly, you placed the additive in the batteries after they had been used from 4½ to 5 years; is that right?

Mr. CUNNINGHAM. No, sir. The batteries, at the time of the treatment ranged from 3 to 4½ years.

Senator SPARKMAN. Three to four and a half?

Mr. CUNNINGHAM. Yes, sir.

Senator SPARKMAN. Now they were mechanically good at that time?

Mr. CUNNINGHAM. They were mechanically sound. The ones that were not mechanically sound—I think there were 2 or 3—were discarded.

Senator SPARKMAN. Tell me this: Why will a mechanically sound battery not take a charge? How can you have a mechanically sound battery that will not take a charge?

Mr. CUNNINGHAM. I can't give you the scientific end of it because I am not a scientist, but, from the layman's end of it, from experience, an old battery will generally get heavily sulfated. During the course of the action, the changing of the sulfuric acid to lead sulfate, a certain amount——

Senator SPARKMAN. In other words, you can have sulfation and still have a mechanically sound battery?

Mr. CUNNINGHAM. Yes, sir.

Senator SPARKMAN. I think that is the thing that I was puzzled about. And then, in your opinion, from your experience in the use of these batteries, you believe that AD–X2 prolonged the life of the used batteries?

Mr. CUNNINGHAM. I definitely do; and it is the opinion of quite a few of the men who used it on their vessels. They also have the same idea.

Senator SPARKMAN. Did you say how long you had a rating as chief engineer?

Mr. CUNNINGHAM. No, sir.

Senator SPARKMAN. Well, how long? That is your position, isn't it?

Mr. CUNNINGHAM. Well, I came back from overseas in 1944, and I went up into the port engineer's rating then.

Senator SPARKMAN. You were port engineer, and then I understood you got bumped.

Mr. CUNNINGHAM. Yes, sir; I went back to chief engineer for approximately a year and a half, and then I came back to the office again as a marine surveyor.

Senator SPARKMAN. Your rating now is not chief engineer?

Mr. CUNNINGHAM. No, sir.

Senator SPARKMAN. Marine surveyor?

Mr. CUNNINGHAM. No; I am now Chief of the Planning and Survey Section. We write specifications.

Senator SPARKMAN. Do you still have supervision over batteries, battery service, and such as that?

Mr. CUNNINGHAM. On inactive craft in procurement, but not on the active craft. The active craft has now been turned over to a different division.

Senator SPARKMAN. Are you a civilian or are you in the Army service?

Mr. CUNNINGHAM. Civilian; civil service.

Senator SPARKMAN. I believe that is all, Mr. Chairman.

The CHAIRMAN. Senator Duff.

Senator DUFF. When you were speaking of them being sulfated, you mean that the porous bases are all filled up as a result of use; is that it?

Mr. CUNNINGHAM. Yes, sir. As a rule, hard crystals of sulfate will form on the plates. These crystals remain in the sulfate form and do not go back into solution when you charge the battery.

Senator DUFF. In your opinion, does that AD–X2, among other things, take off those clogging particles and give the porosity again? Is that it?

Mr. CUNNINGHAM. Through experience with the material, it seems to eliminate excessive charging. The battery seems to take less charge, less gassing, and use less distilled water.

Senator DUFF. This is his formal statement here, isn't it?

The CHAIRMAN. Yes.

Senator DUFF. I understand from that statement you have used over 2,000 treatments of this Battery AD–X2.

Mr. CUNNINGHAM. Yes, sir; approximately.

Senator DUFF. And what proportion of those 2,000 treatments did you find to be defective?

Mr. CUNNINGHAM. We didn't find any defective.

Senator DUFF. Effective?

Mr. CUNNINGHAM. That is what I was trying to explain. Out of the 158 batteries that we had treated in March and April of 1949——

Senator DUFF. I understood that. It says here "We have used over 2,000 treatments of AD–X2 in our batteries." What do you mean by that 2,000 treatments?

Mr. CUNNINGHAM. That was 2,000 packets. Now, in each packet there were three envelopes. In our marine-type batteries they have a very large capacity from what a little automotive-type battery has, and in some cases you have to use 3 or 4 envelopes per cell. We used the amount of electrolyte that is in the battery.

Senator DUFF. In other words, you gave about 2,000 treatments to the number of batteries——

Mr. CUNNINGHAM. To these 158 plus 14 in another vessel, plus 24 in another, and plus 21 in the shop.

Senator DUFF. I merely wanted to get that straight in my own mind.

The CHAIRMAN. Senator Smathers?

Senator SMATHERS. I wasn't here before. What was your name, again?

Mr. CUNNINGHAM. Erwin George Cunningham.

Senator SMATHERS. Mr. Cunningham, have you worked for anybody else in the last 3 or 4 years besides the Army Transport?

Mr. CUNNINGHAM. Prior to coming to work for the Army I worked for American President Lines, prior to that I worked for Whitney Bros.

Senator SMATHERS. Since 1949, who have you worked for?

Mr. CUNNINGHAM. Right with the Army. I have been with the Army since approximately 1943.

Senator SMATHERS. Then you are a civilian with the Army, today?

Mr. CUNNINGHAM. Yes, sir.

Senator SMATHERS. These batteries that you treated with the AD–X2 treatment, what did you do to those batteries before you applied the powder?

Mr. CUNNINGHAM. We tried to charge them over a period of time. We learned through experience that as a rule you charge a battery at the rate of one amp per each positive plate, each positive plate in any one cell, so as not to exceed the manufacturer's recommendation or to burn the battery up.

You try to put back into the batteries—in a 200 amp power battery, you try to put that many amp powers back in it. But, you don't keep charging if it doesn't come up. You stop after a period of time, say 24 or 48 hours, so that you don't overcharge the battery or cook the plates.

We attempted to bring them back up through charging. We have learned that sometimes you can break sulfation loose out in the field, by what we call a slug charge, throw in a high amperage through the batteries. Sometimes it does it, but it invariably breaks the sulfate off, and all the active material comes off and ends up in the bottom of the battery, which will invariably short out the cells.

Senator SMATHERS. Did you disassemble the batteries?

Mr. CUNNINGHAM. No, sir; we did not. That would come under depot maintenance. We do not have the facilities aboard vessels to do that.

Senator SMATHERS. I am a little bit confused at the moment. One hundred and fifty-eight batteries, are these the ones that you treated yourself, right there on your place in your facilities?

Mr. CUNNINGHAM. Yes, sir; that was among 12 different vessels.

Senator SMATHER. And you treated all those right there in the port?

Mr. CUNNINGHAM. Yes, sir.

Senator SMATHERS. And you did not clean them?

Mr. CUNNINGHAM. Internally, no; externally, we always keep the battery clean so we don't have any——

Senator SMATHERS. Did you take them out of the ships when you got ready to treat them?

Mr. CUNNINGHAM. No.

Senator SMATHERS. You left them right where they were?

Mr. CUNNINGHAM. Yes, sir.

Senator SMATHERS. And you cleaned them first?

Mr. CUNNINGHAM. No. As a rule the chief engineer and his oiler keep the batteries in a first-class condition. It is up to them to main-

tain that, keep acid, and so forth, that is being spilled around there, keep that cleaned up.

Senator SMATHERS. Then you attempted to apply the charge without even cleaning them?

Mr. CUNNINGHAM. No. I say they are in a clean condition. You walk aboard some of the vessels and you could eat off the deck plates.

Senator SMATHERS. Some of them I have seen, I wouldn't want to eat on.

Mr. CUNNINGHAM. When you have an IG inspection coming on board about once a month, it better be clean.

Senator SMATHERS. What I am trying to get at is this: I notice on this little package, of which I have been able to get one—which I am going to try some day—it says that the first thing you do is clean the top of the battery and the post. Those are the directions. Did you do that?

Mr. CUNNINGHAM. Our batteries are never in that kind of a deplorable condition such as you will find in an automobile. They are probably referring to a lot of that green fuzz you see all over the terminals.

Senator SMATHERS. It says, "Cover the plates with water."

Mr. CUNNINGHAM. We always keep our plates—once a week they are watered. The batteries are watered once a week.

Senator SMATHERS. It says, "Empty one envelope into each cell." You said a moment ago that you charged it. I wrote down what you said. You said you charged the batteries and, then, thereafter you added the AD–X2 solution.

Mr. CUNNINGHAM. Maybe I didn't make myself clear. First we attempt—we charged the batteries and attempted to bring them back up to the manufacturer's specification after so long a period. I don't know whether it is 24 or 48 hours. It depends upon the size of the battery and the amount of amperage you are putting into the battery.

I am referring to a vessel where we have controlled charging such as what you would have in a battery shop. Some of the smaller vessels, the commandos, and stuff like that, would be equivalent to an automobile where they have a voltage regulator in conjunction with a generator. In that type of battery you do have no control over the charging rate of it.

Senator SMATHERS. So you charged it?

Mr. CUNNINGHAM. Charged it first to see if we could increase the specific-gravity reading.

The CHAIRMAN. Did you?

Mr. CUNNINGHAM. No, sir.

Senator SMATHERS. In none of the 158 were you able to charge them?

Mr. CUNNINGHAM. Oh, sure; but what we took down was the highest reading, and their highest readings did not come up to the manufacturer's specifications.

Senator SMATHERS. So you then charged them?

Mr. CUNNINGHAM. They had been charged. They came up as high as they could go. Then we treated them with the AD–X2. Then, during the course of normal working cycling of the battery——

Senator SMATHERS. Normal what of the battery? What was that word?

Mr. CUNNINGHAM. The normal working of the battery, the cycling of it, charge and discharge over a period of time. In some cases it was 3 weeks later, some cases a month later, that we took another specific-gravity reading of the batteries, and in most cases they came up to the manufacturer's specifications or within a few points.

The CHAIRMAN. And those were batteries which you could not bring up until you made the application. Is that what we are to understand?

Mr. CUNNINGHAM. Yes, sir; but I would like this to be understood: Those batteries were not 100 percent dead. They were not junk batteries. They were batteries that were serviceable, but some of them were very low in specific gravity, which meant that they had to keep them on the charge continually.

Senator SMATHERS. You said that these marine batteries had a life expectancy, even though the manufacturer wouldn't give you any specific time, which you said would run about 5 years.

Mr. CUNNINGHAM. At the time we treated the batteries we took the strap data off of it and some of them averaged 3 to 4½ years. So it must have had at least that much of a life expectancy or they wouldn't have lasted that long.

Senator SMATHERS. Ordinarily, when you buy a marine battery of that particular kind which you were using, what was the life expectancy of it?

Mr. CUNNINGHAM. That I don't know. We use so many different types of batteries. In the Government you use all different brands.

Senator SMATHERS. If you don't know that, then the batteries were not dead?

Mr. CUNNINGHAM. Not 100 percent dead; no, sir. There were a few that were.

Senator SMATHERS. They were mechanically in good shape?

Mr. CUNNINGHAM. Mechanically sound; yes, sir. There were no broken cells, as far as we knew, because it would have showed up on the voltage test.

Senator SMATHERS. And then after they were mechanically good and weren't completely dead, you charged them as high as you could get them to go?

Mr. CUNNINGHAM. Yes, sir.

Senator SMATHERS. And thereafter you put in the AD–X2?

Mr. CUNNINGHAM. Yes, sir.

Senator SMATHERS. Have you ever tried any other additive besides AD–X2?

Mr. CUNNINGHAM. Not aboard any of the vessels. Quite some time ago—when you asked me where I worked prior to that—I worked out at Whitney Bros. and we always did have battery trouble out there, also. Whitney Bros., incidentally, is an amusement park, and we had a lot of equipment running off of batteries.

We used to use old Dodge generators, convert them to motors. During the summer months, 7 or 8 months, you would run a pretty steady stream like at Palisades. Then the rest of the time you would lay up the batteries.

When you would use the batteries at the beginning of the next summer season, they would be dead. So, we experimented with different types of additives; something to eliminate the battery headache?

Senator SMATHERS. Did you ever find an additive previous to this time that was satisfactory?

Mr. CUNNINGHAM. No, sir; I did not.

Senator SMATHERS. This was the first one you found?

Mr. CUNNINGHAM. Yes, sir.

Senator SMATHERS. Did you ever use an additive called Protecto-Charge?

Mr. CUNNINGHAM. Well, at the time that we had requisitioned this material, prior to that, I think the material was called Protecto-Charge. When we got it it was AD–X2.

Senator SMATHERS. In other words, you ordered it as Protecto-Charge?

Mr. CUNNINGHAM. No; we ordered it as a desulfater.

Senator SMATHERS. But you ordered it for the purpose of helping to improve the batteries?

Mr. CUNNINGHAM. Yes, sir.

Senator SMATHERS. And at the time you ordered it, it was known as the Protecto-Charge?

Mr. CUNNINGHAM. I don't know when they changed from Protecto-Charge to AD–X2. I couldn't answer you that. If I remember right, it was AD–X2 on the packages.

Senator SMATHERS. I just got this from you. I thought you said at the time you ordered it it was Protecto-Charge.

Mr. CUNNINGHAM. No, sir. I never mentioned anything about Protecto-Charge.

Senator SMATHERS. Have you ever used Protecto-Charge?

Mr. CUNNINGHAM. No, sir; I have not.

Senator SMATHERS. You know nothing about it?

Mr. CUNNINGHAM. I don't know anything about it. If that is the same thing as AD–X2, yes, sir, I have used it.

Senator SMATHERS. Now, you told about 14 batteries which were serviced which you took into their shop?

Mr. CUNNINGHAM. Yes, sir.

Senator SMATHERS. And they came back apparently in workable and usable condition?

Mr. CUNNINGHAM. Yes; they were serviced by the AD–X2 people.

Senator SMATHERS. Do you think that the service by itself would be beneficial to the battery? In other words, the charging and the cleaning of the posts and the things of that nature?

Mr. CUNNINGHAM. No; because actually cleaning the top side of the battery and the terminals, I can't see unless they are real filthy and you have a voltage loss, where it would do any harm, unless you spilled that dirt inside the cell, then you will have plenty of trouble.

Senator SMATHERS. Is that unusual, to spill some of the dirt inside the cell?

Mr. CUNNINGHAM. No, aboard ship you don't, because you don't have sand or mud or anything like that, like you would have in a weapons carrier or an automobile.

Senator SMATHERS. I think that is all I have, Mr. Chairman.

The CHAIRMAN. Are you any relation of Mr. Ritchie?

Mr. CUNNINGHAM. No, sir; I am not.

The CHAIRMAN. Are you related to any member of his family?

Mr. CUNNINGHAM. No, sir; I am not.

The CHAIRMAN. Have you ever worked for Mr. Ritchie?

Mr. CUNNINGHAM. No; I have not.

The CHAIRMAN. Do you have any interest in this compound?

Mr. CUNNINGHAM. No, sir; I have not.

The CHAIRMAN. At the time that you commenced to use this compound, you felt, as an engineer, that if you could reduce the sulfation of the battery, you would have a better performance?

Mr. CUNNINGHAM. It would increase the efficiency of the organization, and all Government employees are continually reminded to try to improve on efficiency, and any suggestions they turn in to the suggestion committee to either eliminate waste, excessive spending of money or short-cuts——

The CHAIRMAN. Did you ever receive an award for making a recommendation as a Federal employee?

Mr. CUNNINGHAM. No. In my category as port engineer or as chief planner, now, I think it is part of our job to try to improve efficiency without asking for awards. That is what we are paid for.

The CHAIRMAN. Sometimes they do offer awards if someone is able to either cut down the time or increase the efficiency.

Mr. CUNNINGHAM. Yes, they do, provided you turn in that suggestion in writing and it is approved.

The CHAIRMAN. Yes, sir; that was the purpose of my question. The fact was that because you had worked with storage batteries over a number of years, when you had the responsibility of this group of batteries, you were trying to prolong the efficiency of the battery and the life of the battery?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. And you found some batteries, that regardless of whether you put them on the charge or not, you were not able to bring them up to the readings of a new battery, or the manufacturer's reading?

Mr. CUNNINGHAM. That is correct.

The CHAIRMAN. And then you knew that that battery would not perform well in service, and you were trying to perfect or improve the condition of that battery so that it would perfrom correctly?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. And that was when you put in a requisition for AD–X2?

Mr. CUNNINGHAM. That is correct.

The CHAIRMAN. Had anybody been around trying to sell you on the product?

Mr. CUNNINGHAM. Not to my knowledge.

The CHAIRMAN. You then obtained the compound and you put it in the batteries and it was your observation that as you checked the batteries from time to time, the batteries came up to the normal reading or the manufacturer's reading or specifications?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. And that the battery, so far as you knew, and all the batteries that are still under your command, or under your supervision, are performing perfectly?

Mr. CUNNINGHAM. Yes, sir; up until—like I say, the last time I checked was in September 1952. At that time 44 were out of commission. What was wrong with them, I don't know. We had no tests on them. We did not pull them apart to determine.

The CHAIRMAN. What about the others?

Mr. CUNNINGHAM. The others are still in operation or stored in a battery shop in a serviceable condition.

The CHAIRMAN. If this were your own money and your own batteries so that you had the financial responsibility, would you do the same as you are doing now?

Mr. CUNNINGHAM. I believe I would. Maybe I am being hoodwinked, but from the results we got from the product, in my opinion and other operators' and chief engineers' opinions, we seem to be satisfied with the product.

I stand to be corrected if I am wrong, but if I remember correctly at the time we had purchased the material, it was bought on a money-back guarantee or a replacement of any battery that was damaged through the use of it. We had no battery that was damaged through the use of it that we know of, and it did do, so far as I know, what the manufacturer claimed it would.

The CHAIRMAN. And are you continuing to requisition for that every time you put a new battery on the line?

Mr. CUNNINGHAM. No, sir, we are not.

The CHAIRMAN. Why?

Mr. CUNNINGHAM. That I don't know.

The CHAIRMAN. When were you denied the product?

Mr. CUNNINGHAM. Once you treat the battery it requires no more treatment until that battery has a mechanical failure.

The CHAIRMAN. Then the answer is that you have not put any new batteries on the line or you have not put any replacements on, and, therefore, you haven't had a need for it?

Mr. CUNNINGHAM. Yes and no. Where I asked for the use of it, it would come under classified material.

The CHAIRMAN. Wait a minute. Now, let's get this straight. You asked for the use of it and they denied it?

Mr. CUNNINGHAM. Yes. There was some discussion over it at the time.

The CHAIRMAN. What month was this and in what year?

Mr. CUNNINGHAM. The last 3 or 4 months.

The CHAIRMAN. You mean the last 3 or 4 months——

Mr. CUNNINGHAM. Of this year.

The CHAIRMAN. You have sent in a requisition for the compound?

Mr. CUNNINGHAM. No, sir; I did not send in a requisition for it.

The CHAIRMAN. Then what happened that you were denied it? Did an order come out that you were not to use AD–X2 any more?

Mr. CUNNINGHAM. No; not to my knowledge, not recently.

The CHAIRMAN. Well, then, how did you happen to make the statement that you hadn't used any of it in the last 3 months and to answer "yes and no" to my question as to whether there was an order on it, an order out denying you the right to use it?

Mr. CUNNINGHAM. When I say "yes and no"——

The CHAIRMAN. We have got to have a positive answer.

Mr. CUNNINGHAM. Yes; I had asked and suggested the use of it on things that come under classified material.

The CHAIRMAN. Well, a battery can't be classified. It is nothing new.

Mr. CUNNINGHAM. No; the battery itself would not be classified material, but the background of where the battery comes from.

The CHAIRMAN. The background of where the battery comes from; well, where would the battery come from?

Mr. CUNNINGHAM. That is what I mean. That is what is considered out in our port as classified material.

The CHAIRMAN. Well, a battery will come from the manufacturer, will it not?

Mr. CUNNINGHAM. I mean the use of that battery, where that battery is going to be used.

The CHAIRMAN. Where the battery is going to be used is classified?

Mr. CUNNINGHAM. Yes.

The CHAIRMAN. But so far as where the battery comes from, that is not classified?

Mr. CUNNINGHAM. No, sir.

The CHAIRMAN. And you are responsible for that battery, are you not? It is your duty to keep the equipment in the best condition that you know how?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. And your best judgment would have been to put the additive in?

Mr. CUNNINGHAM. Yes.

The CHAIRMAN. And you couldn't get the additive?

Mr. CUNNINGHAM. That is correct.

The CHAIRMAN. And that was in what month of the year?

Mr. CUNNINGHAM. That happened approximately 3 or 4 months ago.

The CHAIRMAN. In other words, it might have happened sometime in the calendar year of 1953?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. And it became the policy that no more AD–X2 would be used, was that it? They didn't give it to you in writing but the order was no more AD–X2?

Mr. CUNNINGHAM. You could put it that way; yes.

The CHAIRMAN. In other words, the authorities over you just simply said no more AD–X2 to be used in any batteries. They didn't give an explanation as to why, or anything?

Mr. CUNNINGHAM. Yes, some of the explanation was theoretically we are not supposed to order anything by a trade name. You can use the trade name as a comparison.

The CHAIRMAN. You could have called for battery powder, couldn't you, that you had been buying before? You could have ordered it in the same manner that you got the first order filled, couldn't you?

Mr. CUNNINGHAM. Possibly.

The CHAIRMAN. All I am trying to find out from you, sir, is who stopped you from using it. That is what I am trying to find out.

Mr. CUNNINGHAM. I imagine that came from a higher echelon.

The CHAIRMAN. Then in other words if it had been left to your decision—and you are the marine engineer, and you are supposed to know something about batteries or you wouldn't be in that position—if it had been left to your good judgment, you would have used the powder, is that it?

Mr. CUNNINGHAM. Yes, sir; I would.

The CHAIRMAN. From all past experience, you know that you would have had less battery trouble if you had been permitted to use the powder?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. And if it had been your own battery and your own money, you would have bought the powder?

Mr. CUNNINGHAM. I would, definitely. I would buy it right now.

The CHAIRMAN. You definitely would?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. And you are positive. You are not equivocating on that one, but you are equivocating on the question of who gave you the denial.

We don't want to embarrass you in any manner. If I knew that anybody caused you any embarrassment because you have been asked to come and testify—and I insisted that the men who worked in this field be privileged to come here and testify—I would take steps to clear that up immediately.

Mr. CUNNINGHAM. No; there hasn't been anything like that. If anything, I would say the Transportation Corps from the start of my trip from San Francisco until the time I arrived here, particularly my commanding officer, Lieutenant Colonel Sanderson in San Francisco, was very cooperative.

The CHAIRMAN. I am glad to hear you say that.

Mr. CUNNINGHAM. Very, very cooperative.

The CHAIRMAN. I expected this would be the case.

Mr. CUNNINGHAM. The colonel right here when I arrived in Washington was very cooperative.

The CHAIRMAN. I knew they would be because we were seeking information, but the main question that I am trying to get the positive answer to is, you don't know why the powder is not permitted to be used any further? All you know is that were you privileged to use it, you would use it because it is your strong conviction that it would give you some benefit in the care of that battery.

Mr. CUNNINGHAM. Yes. It is a possibility the reason why we can't use it is probably from the National Bureau of Standards' negative test on it. That is a possibility. That is one thing I can't understand, why laboratory tests, some of them showed negative, some showed positive.

I was just wondering if it could have been the application of the powder in the battery. We have found the first time you attempt to put the powder in the battery you have quite a time pouring it in. You should pour it in very slow and keep diluting it. I have found cases where people have used it and claimed that it didn't do the battery any good.

I found out they dumped the electrolyte out of their battery, put it in a glass jar and then poured the powder into the glass jar, stirred that up and poured it back into the battery. I understand that the catalyst that is supposed to be these trace elements inside the powder possibly clings to the glass jar or whatever you had mixed with it. I am just wondering if that is what has happened in some of these laboratory tests or if they cooked up the battery before they added the stuff.

The CHAIRMAN. We here know nothing about these phraseologies that you men use with reference to these batteries. When you say "cook up" that is an overcharge?

Mr. CUNNINGHAM. That is an overcharge.

The CHAIRMAN. What happens if the battery is overcharged before you add the compounds?

Mr. CUNNINGHAM. You might just as well throw the battery into the junk yard and sell it for lead.

The CHAIRMAN. Why?

Mr. CUNNINGHAM. Invariably when it is overcooked, it is overheated; and when it is overheated, the positive plates as a rule will buckle; and when they buckle or warp out of shape, they break down the separators; then you have a short between the positive and negative plate. Then your battery is absolutely worthless.

The CHAIRMAN. Then your battery has got a short?

Mr. CUNNINGHAM. A short.

The CHAIRMAN. If particles of lead can build themselves up, they too, can short a segment of the battery?

Mr. CUNNINGHAM. That is correct. If, during the overcharge, you were lucky and removed some of the lead sulfate from the battery, the hard crystals, invaribly the active material that is clinging to the lead sulfate has dropped to the bottom of the battery and that also helps short out the battery when it builds up high enough.

The CHAIRMAN. Well, I am not a sufficient expert on the question to ask intelligent questions to draw you out any further on it. But, all I can say is that you know that somewhere up above they just simply said no more additive was to be used, and that came along about 3 months ago?

Mr. CUNNINGHAM. Yes, sir. Prior to that there had also been some more comments on it. Back around 1951, I imagine it was.

The CHAIRMAN. You heard some comments about it, but you still were using it?

Mr. CUNNINGHAM. We had treated all the batteries that needed treatment in 1949. Like I say, this is not a repeat product. Once you treat the battery you don't have to treat it again, and we would have treated everything when we started getting new batteries and new vessels and things of that nature. I would like to try it on stored batteries taken in off inactive craft. That would be a very interesting experiment.

The CHAIRMAN. But when you applied it, your batteries were clean as all mechanics are compelled to keep the equipment that they have used?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. They have to keep it in condition, so you had nothing to clean. You didn't have to dislodge any of the connections or anything. You just opened the cap on the battery cell and you poured the powder in?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. And then you were careful to keep stirring that powder down into the liquid inside the battery until you got all the powder down in?

Mr. CUNNINGHAM. Dissolved; yes, sir.

The CHAIRMAN. And that was all that you did?

Mr. CUNNINGHAM. That was all. It did make everybody, let's say, more battery conscious. By that I mean it was interesting. Quite a few of the engineers and operators assigned to the respective vessels had read about it or had seen people use it, and they were very much interested in it.

The CHAIRMAN. Do you use it in your own automobile?

Mr. CUNNINGHAM. Yes, sir; my automobile, the race car and the airplane battery.

The CHAIRMAN. Wait a minute, let's have that a little slower.

Mr. CUNNINGHAM. I use it in everything I've got.

The CHAIRMAN. You have an automobile, a racing automobile?

Mr. CUNNINGHAM. And the airplane.

The CHAIRMAN. And an airplane. Are you an automobile racer?

Mr. CUNNINGHAM. I am slowing up quite a bit now, though. The foot's getting ballooned.

The CHAIRMAN. But you have been a mechanic or you have been a marine engineer——

Mr. CUNNINGHAM. I have been shipmates with mechanics' batteries, because for every piece of equipment you have, you have to have some means of getting it started, or some means of getting the ignition system started either through a magneto or a battery. I have always had batteries as long as I can remember.

The CHAIRMAN. What was the experience that you had that first interested you in the product?

Mr. CUNNINGHAM. Well, if I remember right, I read something about tests or the use of it on the Oakland city radio cars or fire trucks or their marine fireboat they have over there.

The CHAIRMAN. And that interested you to a point that you got a package and started using it?

Mr. CUNNINGHAM. That's it. Then another time if I recall rightly, when I was up at Clear Lake on a vacation, I had seen on motorboats that people would generally come up maybe 2 or 3 months out of the year and leave their boat there the rest of the year. Their battery sulfates up very badly, and I had noticed this man, if I remember right at that time, had got some of it and put it in some of those sulfated batteries. He got very good results out of it.

The CHAIRMAN. And that led you to believe that you should try it, and your own experience then convinced you that it had some beneficial effect upon the battery?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. Are there any further questions?

Senator SMATHERS. Mr. Chairman, let me just ask one or two questions. Did you treat these batteries yourself, or did the people who worked under you?

Mr. CUNNINGHAM. The people who worked under me, under my supervision. At the time I had used quite a bit of it myself.

Senator SMATHERS. Did you put out any written instructions as to how this was to be done?

Mr. CUNNINGHAM. I had one man working with me who had been given written instructions after I talked with Pioneers, Inc., as to the exact means of using the product. We followed that out to the "T," because as a rule every time you get a new product, there are always certain ways and means of using it.

Senator SMATHERS. Do you have a copy or could you make available to us a copy of the instructions which you gave to these people as to how to use it?

Mr. CUNNINGHAM. There are probably some SOP's left on some of the old vessels. It was merely to check batteries first for mechanical soundness, then to charge them at a a slow rate to try to increase

the specific gravity to the manufacturers' specification, but to not overcharge.

Then we took readings of all those batteries. Now some of them may be 50 percent charged, 60 percent charged, 75 percent charged. There were all different variations. Then after the addition of the AD–X2, the battery was left to work in its normal course.

On some of the smaller vessels that did not have outside means of charging, just merely the generator and voltage regulator, the engines were run for 3 or 4 weeks and checked again.

Senator SMATHERS. In every instance of these 158 batteries, you say they went up to manufacturers' specifications?

Mr. CUNNINGHAM. Yes, sir; in a couple of cases if I remember correctly, we had to draw acid off. The specific gravity reading exceeded the manufacturer's specifications by a few points. The acid was drawn off, and then the electrolyte was refilled with distilled water.

Senator SMATHERS. Of the 158 cases when you recharged them, you say that none reached the manufacturer's specifications—of the 158, not a single 1?

Mr. CUNNINGHAM. No; to my recollection they did not.

Senator SMATHERS. You say in 1949 you heard some complaint about the use of AD–X2?

Mr. CUNNINGHAM. Yes; if I remember rightly, I had given it to a couple of friends of mine, and I saw them a couple of weeks later, and they were moaning and groaning that their battery was no good. I said, "What's the matter?"

"We put some of your AD–X2 in, and it is worse now than it ever was."

They were the ones I found had poured the powder into a glass jar, dumped the electrolyte out into the glass jar, poured the powder in, and then filled the battery, but theirs had a mechanical defect. They had one bad cell. As fast as you charged it up, it would drain itself.

Senator SMATHERS. Of these 158 batteries that you tried, none of them had any mechanical defects, or none of them had any bad cells?

Mr. CUNNINGHAM. The ones that had mechanical defects we did not treat. We pulled them out of the vessel and installed——

Senator SMATHERS. So of the 158, there were none that had any mechanical defect or none that had any bad cells?

Mr. CUNNINGHAM. That's right, aboard the vessels.

Senator SMATHERS. Did you try the additive on any besides this 158?

Mr. CUNNINGHAM. Yes, sir; we tried it on 21 batteries in the battery shop. Out of the 21, 17 responded and 4 had bad cells. Now I did not supervise that test. It was not a test. It was just more of an experimental use of the product.

Senator SMATHERS. And some of those didn't work, is that the idea?

Mr. CUNNINGHAM. Seventeen out of the twenty-one were O. K. Four had defective cells. In other words, they were mechanically unsound.

Senator SMATHERS. Did the fact that you were using the AD–X2 have anything to do with your being bumped from the port engineer to the chief engineer?

Mr. CUNNINGHAM. That, I doubt.

Senator SMATHERS. I am just asking. I am not making any charge. You say you doubt it. Is that your answer?

Mr. CUNNINGHAM. No, I don't believe it had. I don't see how it could have anything to do with it at the time.

Senator SMATHERS. Are you inferring to us—and I think it is something we should be concerned about—that because of this trouble which we will say AD–X2 has had with the Federal Government, that that is the reason you are not ordering any more?

Mr. CUNNINGHAM. Could I hear that again, sir?

Senator SMATHERS. Are we to believe that because the AD–X2 has been condemned, we will say, by the Post Office Department, that that is the reason you have not been permitted to order any more?

Mr. CUNNINGHAM. I can't truthfully say "Yes." It is a possibility.

Senator SMATHERS. Do you know why you are not permitted to order any more?

Mr. CUNNINGHAM. No. When you talk to higher authorities for the use of it, it is not on the approved list. For one thing, it is not on the TC stock.

Senator SMATHERS. Has it ever been in the stock catalog?

Mr. CUNNINGHAM. No, sir. It would be considered a nonstandard item.

Senator SMATHERS. How did it happen that you were able to get it in 1949 and 1950 if it was not in the stock catalog?

Mr. CUNNINGHAM. At that time we had requested a desulfater for the batteries and it went through regular channels, and we ended up getting it.

Senator SMATHERS. Now when you ask for it, they do not permit you to get it even though you proceed exactly the same way that you did originally?

Mr. CUNNINGHAM. I have not turned in any written request for it because I am no longer in charge of active craft, but we would start a requisition.

Senator SMATHERS. You have not made any requests for it, is that correct?

Mr. CUNNINGHAM. In writing?

Senator SMATHERS. In writing.

Mr. CUNNINGHAM. Yes, sir.

Senator SMATHERS. And why haven't you?

Mr. CUNNINGHAM. The active craft no longer come under our division.

Senator SMATHERS. In other words, you just haven't had any need for AD–X2?

Mr. CUNNINGHAM. No; I wouldn't put it that way. Probably more so now than ever. We have a lot of batteries stored in the battery shop.

Senator SMATHERS. Were you told not to make a written request for it?

Mr. CUNNINGHAM. No; that comes under a different department now.

Senator SMATHERS. If you were not told that you could not order it, why then did you not order it?

Mr. CUNNINGHAM. As I am trying to explain to you, I am no longer in charge of the active craft.

Senator SMATHERS. Didn't you say that you have more need for it now than ever before?

Mr. CUNNINGHAM. Yes. The batteries now come under the mechanical property section.

Senator SMATHERS. If you have more need for it now than you ever did before——

Mr. CUNNINGHAM. That is my personal opinion. Other people's opinions are different.

Senator SMATHERS. As I gathered, they took the jurisdiction of the batteries out from under you?

Mr. CUNNINGHAM. That is MR property, so that belongs to the contract accountable officer.

Senator SMATHERS. At one time you had jurisdiction of the batteries, didn't you?

Mr. CUNNINGHAM. Maintenance of the vessels.

Senator SMATHERS. You treated the batteries, didn't you?

Mr. CUNNINGHAM. Yes, sir.

Senator SMATHERS. And now you no longer treat those batteries?

Mr. CUNNINGHAM. No.

Senator SMATHERS. You don't treat them any more. You have no longer any jurisdiction of them?

Mr. CUNNINGHAM. That is correct, on the active craft.

Senator SMATHERS. If they have taken them away from you, was it because they weren't satisfied with the way you were treating the batteries?

Mr. CUNNINGHAM. No. The active craft were transferred to a different division. That is what I am trying to explain. This Rio Vista storage activity was organized.

Senator SMATHERS. It is regular Army procedure?

The CHAIRMAN. In other words, you were transferred to another position and duty?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. But the man who is in charge of the work in which you had been engaged is not now ordering the powder because it is a new policy laid down that it will not be used. Am I right in that statement?

Senator SMATHERS. What I am trying to get at, he hasn't said that there is a new policy laid down. You are saying that you have more need for them now than you ever had before in your new job. Yet for some reason you are not permitted to order any AD–X2, and I don't think we have had a satisfactory explanation as to why.

Mr. CUNNINGHAM. I said a little while ago I imagine it was on account of the NBS condemning the product.

Senator SMATHERS. That is what you imagine. Let's get at a few facts. Did you request that you be permitted to have AD–X2?

Mr. CUNNINGHAM. Yes, sir.

Senator SMATHERS. Did you write it or did you speak it?

Mr. CUNNINGHAM. Verbal.

Senator SMATHERS. Verbal?

Mr. CUNNINGHAM. Conversation.

Senator SMATHERS. Were you told that you could not order any more AD–X2?

Mr. CUNNINGHAM. Yes, sir.

Senator SMATHERS. That is a good, satisfactory answer. Now, I think that you should be protected if we ask you who told you that. Would that embarrass you to tell us that?

Mr. CUNNINGHAM. Yes and no. The way I was told not to order it was, they thought it should come from higher authority, that the Chief of Transportation should O. K. the use of the product.

Senator SMATHERS. What are they treating the batteries with now?

Mr. CUNNINGHAM. We are not. They are laying in a big battery room.

Senator SMATHERS. They don't even attempt to treat them? They don't attempt to recharge them?

Mr. CUNNINGHAM. We attempt to cycle them. We give them what we call a trickle charge every so often. We have several battery men working in the battery shop, but there is an enormous amount of batteries stored there, and it is a long process. By the time you get back to the ones you started on several months ago, sulfating has already started in.

Senator SMATHERS. After you give them a charge, do you take them out and put them in the boats again?

Mr. CUNNINGHAM. No, sir; they are left right there. They are stored.

Senator SMATHERS. In other words, you are just buying new batteries and storing up batteries that are not completely dead?

Mr. CUNNINGHAM. No, sir. These were batteries that were taken off inactive craft that were returned from overseas; and the other ones are classified material.

Senator SMATHERS. I am trying to get at the batteries that were similar to the 158 batteries which you talked about a minute ago that were kept in such wonderful shape and so clean. Now, what are they doing with those clean batteries that they find, like you did those 158 that are not quite as active as they were? What are they doing with those?

Mr. CUNNINGHAM. They are stored in a warehouse.

Senator SMATHERS. They just bring them in and store them?

Mr. CUNNINGHAM. Yes, sir.

Senator SMATHERS. And what do they do, buy a new battery and put it in this ship?

Mr. CUNNINGHAM. No; these batteries are being removed from inactive craft that come back from overseas, all different types of craft. They are put up for wet storage. The smaller vessels, up to 50 feet, are put in dry storage.

The CHAIRMAN. In other words, these are what is now termed "surplus vessels"?

Mr. CUNNINGHAM. Excess; yes, sir.

The CHAIRMAN. Excess vessels; surplus or excess. They are no longer in use?

Mr. CUNNINGHAM. That is correct.

The CHAIRMAN. You remove the battery in order to salvage the battery, and you put that in the battery warehouse?

Mr. CUNNINGHAM. We store them in a warehouse.

The CHAIRMAN. But as long as they are sulfated and will not come up to a normal reading——

Mr. CUNNINGHAM. No, sir; I didn't say they were sulfated because we do not have the opportunity to get around to checking all those batteries.

The CHAIRMAN. Then what I am getting at here is: Are new batteries being purchased, going into service, where a battery failure occurs?

Mr. CUNNINGHAM. No. So far, we haven't had to do it yet; but we have orders to use batteries out of the battery shop when we need a replacement.

The CHAIRMAN. Do you think that you could save the Government money in those salvaged batteries if you added the additive?

Mr. CUNNINGHAM. Yes; I believe that the batteries in the warehouse now will slowly be deteriorated in another 6 months to a year, and they will only be worth junk for lead.

The CHAIRMAN. Would a battery deteriorate slower if you put the additive in?

Mr. CUNNINGHAM. I am under that impression.

The CHAIRMAN. That is your strong conviction; that, from past experience and observation, the battery would deteriorate slower if it was treated with the AD–X2?

Mr. CUNNINGHAM. Yes, sir; it is my opinion that it will eliminate sulfation, which plagues the battery.

The CHAIRMAN. And when a battery is oversulfated, then that destroys the battery?

Mr. CUNNINGHAM. Yes, sir. It is useless then.

The CHAIRMAN. Do you get new batteries that are oversulfated?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. Is that very often?

Mr. CUNNINGHAM. On this classified material; yes.

The CHAIRMAN. Then if in the event that you get a new battery that is highly sulfated, do you return it to the manufacturer?

Mr. CUNNINGHAM. No. We are just getting deeply involved. I have already been jerked on the carpet once for classified material. I don't like to get involved.

The CHAIRMAN. You don't want to get involved.

Mr. CUNNINGHAM. This is happening right now.

The CHAIRMAN. You mean it is happening right now that new batteries come in that are highly sulfated?

Mr. CUNNINGHAM. Yes, sir.

The CHAIRMAN. What happens to such a new battery?

Mr. CUNNINGHAM. Like I say, we send it back to where it came from.

The CHAIRMAN. Now, then, where does that go when you send it back to where it came from?

Mr. CUNNINGHAM. I imagine it goes back to the manufacturer, although in some cases the batteries were sent to a local battery company, were cycled and charged. I have asked for at least three cyclings of all batteries received, and the specific gravity and the voltage reading on all the batteries before we accept them.

Senator SMATHERS. May I ask a question right here?

As I understand it, these batteries that you are getting back now come from ships which are declared excess, and so you put the batteries away just in storage; is that correct?

Mr. CUNNINGHAM. Yes, sir.

Senator SMATHERS. Now, is that what happened with the 158 batteries? Were they off ships that were in excess?

Mr. CUNNINGHAM. No, sir. They were active craft which are still in operation, with the exception of a few which have been declared excess. Now, the ones that have been declared excess, those batteries have been removed and are now sitting in the battery shop in a serviceable condition.

Senator SMATHERS. What is happening to the batteries which are on active ships?

Mr. CUNNINGHAM. That is what I said. Up until January of 1951, 100 percent were still in use. September of 1952, 28 percent, or 44 of the batteries had to be removed through mechanical failure.

Senator SMATHERS. Did you substitute brand new batteries there?

Mr. CUNNINGHAM. In some cases batteries were taken out of the warehouse, the storage, from other inactive craft that the batteries were stored there for and placed in the vessels. The conditions of those batteries I don't know now.

Senator SMATHERS. You don't draw any connection between the change in your jobs and the use of this AD–X2.

Mr. CUNNINGHAM. No; because we had a little politics up at that time between transports and the Army with small craft up to 300 feet.

Senator SMATHERS. I didn't follow you. Because of what?

Mr. CUNNINGHAM. Of the mixup at that time between when the transports were going to be turned over to MSTS, Navy.

Senator SMATHERS. Is your answer to my question "No"?

Mr. CUNNINGHAM. No.

Senator SPARKMAN. You mean yes, it is "No"?

The CHAIRMAN. Is this your prepared statement right here, Mr. Cunningham? It is a part of the record as an affidavit. Therefore, it need not go in the record at this time.

That is all the questions, Mr. Cunningham.

Mr. Emerson Blum. Mr. Blum, you will raise your right hand. Do you swear that the testimony you are about to give pertaining to the matter now before this committee is the truth, the whole truth, and nothing but the truth, so help you God?

Mr. BLUM. I do.

The CHAIRMAN. You may be seated, and proceed.

Mr. BLUM. I wish I had a shot of that AD–X2 right now.

The CHAIRMAN. You look as if you are all right, sir.

All right, Mr. Blum, you may proceed in your own manner and tell this committee what you know about AD–X2. First, let me ask, are you any relative of Mr. Ritchie, the manufacturer?

TESTIMONY OF EMERSON BLUM, FOREMAN, BATTERY SHOP, ORDNANCE DEPARTMENT, BENICIA ARSENAL, BENICIA, CALIF.

Mr. BLUM. No, sir.

The CHAIRMAN. Of his family?

Mr. BLUM. No, sir.

The CHAIRMAN. Have you ever been employed by Mr. Ritchie?

Mr. BLUM. No, sir.

The CHAIRMAN. Have you ever received a commission for the use of the powder in any manner.

Mr. BLUM. No, sir.

The CHAIRMAN. So you have absolutely no interest?

Mr. BLUM. None whatever.

The CHAIRMAN. Now, you are employed by whom?

Mr. BLUM. I am just a civilian employed by the civil service, Ordnance Department.

The CHAIRMAN. In the Ordnance Department?

Mr. BLUM. That's right.

The CHAIRMAN. And you are working where?

Mr. BLUM. Benicia Arsenal, Benicia, Calif.

The CHAIRMAN. How long have you been employed as a civil-service employee?

Mr. BLUM. I have been at the arsenal about 10½ years.

The CHAIRMAN. What is the nature of your work?

Mr. BLUM. Foreman of a battery shop.

The CHAIRMAN. Foreman of a battery shop?

Mr. BLUM. That's right.

The CHAIRMAN. How many years have you been foreman of that battery shop?

Mr. BLUM. Since November 1944.

The CHAIRMAN. How many batteries does this shop normally handle in a day's service?

Mr. BLUM. Well, it is pretty hard to break down by days because some days you do not have many and other days you have an awful lot.

The CHAIRMAN. How many would you estimate?

Mr. BLUM. But I would say that we handle around about 300 a month, that is, actually charged batteries issued out; but we handle much more than that.

The CHAIRMAN. You may proceed, sir, and tell us what you want to tell us.

Mr. BLUM. Well, in the first place, I am not a scientist and I am not a doctor and I am not a mathematician or a technician. I am just an ordinary working guy, and I first met Mr. Ritchie, I believe, sometime during the summer of 1947.

The CHAIRMAN. How did you meet him?

Mr. BLUM. He was brought over and introduced to us by a lieutenant colonel of Ordnance. He brought him over and he had this thing they called Protecto-Charge at that time, so we got to talking about it, and he told me what it would do and what it wouldn't do, and I laughed at him. I told him if he had something like that, why didn't he just take the plates out and throw them away and fill the thing up with water and take off, because I didn't believe it. I've been mixed up with batteries for quite a while, not directly—sometimes directly.

So he said, "Well, here, you might as well take a box and try it," so I am like a kid with a new toy. I did, and what I found out convinced me that AD–X2, as you call it now, was all right.

The CHAIRMAN. What battery? Was that in your personal car?

Mr. BLUM. No, sir; it was an Ordnance battery.

The CHAIRMAN. You put that in an Ordnance battery?

Mr. BLUM. Yes, sir.

The CHAIRMAN. What was the condition of the battery at the time that you put this in the battery?

Mr. BLUM. Well, I used it in lots of them in every condition that you can think of. I got batteries from overseas that were dry. I don't know how long they were dry. I had no way of telling. They were

just dry, and I just put some acid in; I would imagine a weak solution of acid. I didn't make it 1.270 or 1.275 or 1.280. I made it about 1.240; put it on a charger; just poured the dope in and stirred it up. About 70 percent of those batteries came back to life. I don't know how many I did it with.

I did it with quite a number of them, and not only just the type that you speak of as an ordinary automobile battery, but I mean batteries out of LVT tanks, 386-ampere batteries, 12-volt AT batteries with 200-amperes per hour, 120 batteries. and forklift batteries, little long forklift batteries; every kind of battery you can think of, even motorcycle.

The CHAIRMAN. Had you ever used any other kind of a battery additive before?

Mr. BLUM. I never had.

The CHAIRMAN. You never had?

Mr. BLUM. I had read lots about it but I never had used any.

The CHAIRMAN. You didn't believe in it?

Mr. BLUM. I did not.

The CHAIRMAN. But you used this, and what year was it when you first had any experience with it?

Mr. BLUM. In 1947.

The CHAIRMAN. 1947?

Mr. BLUM. Yes.

The CHAIRMAN. And are you still using it?

Mr. BLUM. No, sir.

The CHAIRMAN. When did you cease to get the powder under requisition?

Mr. BLUM. I believe it was in February of 1949, if I remember correctly, when I tried to requisition some more and was told I couldn't get any more.

The CHAIRMAN. In 1949 you were told you could not?

Mr. BLUM. Yes, sir.

The CHAIRMAN. Do you recall the approximate dollar value that you had purchased prior to the order that you couldn't get any more?

Mr. BLUM. You mean why I couldn't get any more?

The CHAIRMAN. The question is about how much money had been spent to your knowledge in this powder, while you were purchasing it.

Mr. BLUM. That is something I couldn't say, because I never saw the invoices.

The CHAIRMAN. About how many packages do you think you used?

Mr. BLUM. I guess I probably had 900 or a thousand, somewhere in that neighborhood.

The CHAIRMAN. Would that be the carton size?

Mr. BLUM. Carton size. I don't know just how many packages were in it.

The CHAIRMAN. They were the carton size?

Mr. BLUM. Packages; I mean; the little tiny packages, treatments.

The CHAIRMAN. You go right ahead and tell us further what you wish to tell us.

Mr. BLUM. Well, we had an old Dodge car there, a pickup, and I took one of those old batteries—I had no way of telling how old it was or anything else—and I treated this battery. I put it in this Dodge weapon carrier and I ran that battery down for 60 days, every day—ran it right down until it would not pull an ounce, killed it right

there, burned the starter up doing it. Every day I ran that down. That's the equivalent, I think, to about 5 years or more use in an automobile, because you certainly aren't going to drag a battery down that much.

The CHAIRMAN. What made you do that?

Mr. BLUM. Just playing. I wanted to see what it would do. I wanted to convince myself, or somebody, myself more than anything else.

The CHAIRMAN. You mean that you were trying to determine it before you made application in all these batteries under your supervision, whether the product had any value or not?

Mr. BLUM. I wanted to find out whether it was any good or not before they spent any money on it.

The CHAIRMAN. If you had done that with a battery that had not been so treated, what would have been your frank opinion as to the effect on the battery?

Mr. BLUM. I think it would have torn it apart. It would have burned up.

The CHAIRMAN. It would have burned it up and destroyed it?

Mr. BLUM. Yes, sir.

The CHAIRMAN. If it was your own financial responsibility to take care of all those batteries that come under your supervision, do you think that it would pay you to buy the product to put in those batteries?

Mr. BLUM. I do.

The CHAIRMAN. Have you endeavored to obtain the compound in recent months?

Mr. BLUM. No, sir.

The CHAIRMAN. You were not able to make a purchase since the year 1949?

Mr. BLUM. That's right.

The CHAIRMAN. And you have endeavored at various times to get it?

Mr. BLUM. I have.

The CHAIRMAN. And you found that the batteries that had had that powder put in them gave better service even over the years from 1949 on up until now than if they had not been so treated?

Mr. BLUM. Yes, sir. I don't know just where all of those batteries have gone.

The CHAIRMAN. Do you believe that the Government would save money on their battery servicing in the event that they were using these compounds?

Mr. BLUM. At the present time, yes, sir.

The CHAIRMAN. Do you have many batteries now that you have under your supervision going into storage, and so forth, because of equipment being dry-stored or dead-stored?

Mr. BLUM. Yes, sir, very much so.

The CHAIRMAN. You have lots of that type of equipment?

Mr. BLUM. Lots and lots of it. We also have batteries coming in from overseas, Japan and Hawaii and Okinawa, every place you can think of.

The CHAIRMAN. Into the thousands?

Mr. BLUM. Well, it would run up into the thousands, pretty close. I wouldn't say just how many thousand, but there would probably be 10 or 12 of them in the course of a year.

The CHAIRMAN. And you service them and then send them back out?
Mr. BLUM. No, sir.
The CHAIRMAN. They are put in storage?
Mr. BLUM. About 65 percent of them that come in to us are broken. Why they ship them to us I don't know. They come in with broken cases, broken tops, piled on top of one another. Why they are done that way I couldn't say.
The CHAIRMAN. What do you do with them?
Mr. BLUM. They go to salvage.
The CHAIRMAN. They are just junk?
Mr. BLUM. That's right. They go to the salvage officer.
The CHAIRMAN. When they are broken, they go to junk. Anything that is serviceable you put back on the line?
Mr. BLUM. We put it back on the line, and if it doesn't show up, why, out in the junk it goes. There is nothing we can do about it.
The CHAIRMAN. But it is your honest opinion that you could save money if you were permitted to treat those batteries and reduce the sulfation; you would in that manner extend the life of the battery?
Mr. BLUM. I believe that we could save many by using it.
The CHAIRMAN. Do new batteries come in to you?
Mr. BLUM. Yes, sir; lots of them.
The CHAIRMAN. Do any of them come in highly sulfated?
Mr. BLUM. They are now, sir.
The CHAIRMAN. How many are now highly sulfated?
Mr. BLUM. Well, right at the present time I have got about 2,000 new ones that came in, and I venture to say that they are all under a certain degree of sulfation. How bad, I don't know. We have only run across about 200 so far in the last couple of months.
The CHAIRMAN. They are highly sulfated?
Mr. BLUM. Yes, sir.
The CHAIRMAN. What do you do with them?
Mr. BLUM. They go to the junk yard.
The CHAIRMAN. You mean a brandnew battery?
Mr. BLUM. That's it. There is no repair to them.
The CHAIRMAN. You mean a brandnew battery that comes to your depot?
Mr. BLUM. Yes, sir.
The CHAIRMAN. That has never been used?
Mr. BLUM. Well, they have been used.
The CHAIRMAN. I am now speaking about brandnew batteries.
Mr. BLUM. These are. These come in brandnew machines that are shipped from the eastern part of the United States out to California with batteries in them that have been brought to a full charge and probably used just to drive the machines into a car, into a flatcar.
The CHAIRMAN. What kind of a machine?
Mr. BLUM. Jeeps.
The CHAIRMAN. Any other kind of equipment?
Mr. BLUM. All other Ordnance equipment that comes with these new batteries.
The CHAIRMAN. I mean jeeps and trucks?
Mr. BLUM. Yes, sir.
The CHAIRMAN. Any tanks?
Mr. BLUM. We haven't run across any tanks yet.

The CHAIRMAN. But jeeps and trucks, and what other equipment?

Mr. BLUM. Well, that is most all that has come in now—jeeps and 2 or 3 different types of trucks.

The CHAIRMAN. And you say they come with batteries that are highly sulfated?

Mr. BLUM. Yes, sir.

The CHAIRMAN. And when a battery is highly sulfated you can't give it a charge?

Mr. BLUM. When they get too bad you cannot.

The CHAIRMAN. You cannnot, and you have had to jerk those batteries out of that brandnew equipment and put in a new battery?

Mr. BLUM. Yes, sir; that's right.

The CHAIRMAN. And they go to the junkyard?

Mr. BLUM. That's right.

The CHAIRMAN. Do you think that the brandnew battery with an application of this compound would become serviceable?

Mr. BLUM. Yes, sir.

The CHAIRMAN. You know you are under oath, sir.

Mr. BLUM. I don't care; I still believe it.

The CHAIRMAN. You still have that strong knowledge and conviction?

Mr. BLUM. I have.

The CHAIRMAN. Because of your years of experience?

Mr. BLUM. That's right.

The CHAIRMAN. That if you could make an application of this powder, that battery would come back into service?

Mr. BLUM. Yes, sir.

The CHAIRMAN. And have you asked for the powder?

Mr. BLUM. I have.

The CHAIRMAN. And they say it is not on your standard equipment and they deny it to you?

Mr. BLUM. No; they didn't say it wasn't on standard equipment. I have a boss. I work under a boss just like anybody else, and I put my requisition in to him. He said they canceled it up on the hill; that's all I know.

The CHAIRMAN. He said they canceled it up on the hill?

Mr. BLUM. That's all.

The CHAIRMAN. But your honest, frank opinion is that you could save the life of that battery?

Mr. BLUM. I know that I could.

The CHAIRMAN. And put that battery back because it has only been in the vehicle for the length of time that it came from the factory to your Ordnance?

Mr. BLUM. Yes, sir.

The CHAIRMAN. And most of that has been in railroad or steamship transportation?

Mr. BLUM. That's right. I wouldn't venture to say that I could save every one, but I believe I could save 95 percent of them.

The CHAIRMAN. Turn them back to a normal condition?

Mr. BLUM. Yes, sir.

The CHAIRMAN. Any other questions?

Senator SPARKMAN. For the sake of the record, when you say about their being stopped up on the hill, that refers to some place out there, doesn't it, not this Hill?

Mr. BLUM. That's right. That's God's country up on the hill.

Senator SPARKMAN. What causes these new batteries to be sulfated—just standing without being used?

Mr. BLUM. That's right. They acid them up, brought them to a full charge, put them in a vehicle and shipped them. Coming out that distance under a hot sun, the water dries out of them, the plates sulfate, and that's all there is to it.

Senator SPARKMAN. If they are going to ship those things and not drive them, why don't they let the battery stand until it reaches you?

Mr. BLUM. I don't see why they don't ship dry-charged batteries and let us put the acid in at the point where the vehicle is going to be driven. They have them, but they don't ship them.

Senator SPARKMAN. Have you asked for that?

Mr. BLUM. Well, I am not anybody to tell them about how they are going to get their vehicles on contract. They get them over here in Detroit, or some place like that. You can't tell those big engineers anything, just a little fellow like me.

Senator SPARKMAN. That's all.

The CHAIRMAN. Senator Duff?

Senator DUFF. Do you think it would be highly beneficial and profitable for the Government to allow you to use this AD–X2?

Mr. BLUM. I certainly do. One reason that I am so convinced of this: I don't have any, but I would sure like to have some to try it on these new batteries that we are getting in. These little 12-volt batteries that fit in these jeeps have a very thin plate, and they charge at a very low amperage rate; 2½ amperes is all you can charge them. You put 3 amperes on them and they get hot. You have got to charge them very slow and easy.

They are tricky, and it takes about 60 hours of that 2½-ampere charging to bring 1 of them up, and you can test them hour after hour, and hour after hour, and they will show a practically dead gravity, and all of a sudden in 30 minutes they are up just like that, finished. They come up with a bang. Why, I don't know.

They are built just like any other battery, only they have very, very thin plates, and they sulfate very easily and they fall apart very easily.

The CHAIRMAN. Do you think that that powder would keep them from sulfating?

Mr. BLUM. I am positive that it will.

The CHAIRMAN. And you think that they would not fall apart as readily?

Mr. BLUM. No, sir; I do not.

The CHAIRMAN. You do not?

Mr. BLUM. No, sir.

The CHAIRMAN. Senator Smathers?

Senator SMATHERS. No questions.

The CHAIRMAN. Those are all the questions we have for you, sir.

Mr. BLUM. Thank you, sir.

The CHAIRMAN. We will meet tomorrow morning in room 457, and we will start with Dr. Harold Weber of the Massachusetts Institute of Technology.

(Whereupon, at 5:45 p. m., the committee recessed, to reconvene at 10 a. m., Thursday, June 25, 1953.)

BATTERY AD-X2

THURSDAY, JUNE 25, 1953

UNITED STATES SENATE,
SELECT COMMITTEE ON SMALL BUSINESS,
Washington, D. C.

The committee met, pursuant to recess, at 10:05 a. m., in room 457, Senate Office Building, Senator Edward J. Thye (chairman) presiding.

Present: Senators Thye (chairman), Ferguson, Sparkman, Gillette, and Smathers.

Also present: Robert A. Forsythe, chief counsel; Blake O'Connor, professional staff member; and William D. Amis, investigator.

The CHAIRMAN. The committee will please come to order. If Dr. Weber will move up to the table here and take that chair at the end of the table, we will proceed. Good morning, Doctor.

Dr. WEBER. Good morning, sir.

The CHAIRMAN. Dr. Weber, we will want to swear you in. Do you swear that the testimony you are about to give pertaining to the matter now before this committee is the truth, the whole truth, and nothing but the truth, so help you God?

Dr. WEBER. I do.

TESTIMONY OF DR. HAROLD C. WEBER, PROFESSOR OF CHEMICAL ENGINEERING, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, CAMBRIDGE, MASS.

The CHAIRMAN. Dr. Weber, it has always been customary for the witness to proceed in his own manner. You may either make a verbal statement or you may read your prepared statement. I hope that we will refrain from asking you any questions until you have completed your statement, and then we will proceed to ask all the questions that the committee members have.

Dr. WEBER. With your permission, Mr. Chairman, I would like to read a statement which I have brought with me.

The CHAIRMAN. You may proceed.

Dr. WEBER. This is a statement from the office of the provost of the Massachusetts Institute of Technology, and it is a statement to the Select Committee on Small Business of the United States Senate, and it is addressed to the attention of the chairman, the Honorable E. J. Thye:

This statement has been prepared to accompany testimony of Dr. Harold C. Weber before the Select Committee on Small Business for the purpose of clarifying tests made at the Massachusetts Institute of Technology on a battery additive know commercially as AD-X2.

1. On October 8, 1952, a letter was addressed by Mr. Blake O'Connor, staff member of the Select Committee on Small Business, to Dr. J. A. Stratton, vice president and provost of the Massachusetts Institute of Technology, requesting on behalf of Senator Sparkman, the committee chairman, that MIT make available space, facilities, and personnel for laboratory tests of a lead storage-battery additive known commercially as AD–X2. A copy of Mr. O'Connor's letter is attached.

2. On the same date, Mr. O'Connor wrote to Prof. Harold C. Weber of the department of chemical engineering at MIT, pointing out that additional tests of AD–X2 were needed and expressing the hope that he would offer his services to conduct such tests, analyze the findings, and report them to the committee.

3. For some time previous to the receipt of these requests Professor Weber had served without fee as a consultant to the Select Committee on Small Business in connection with battery additive AD–X2. During this period Dr. Weber kept the administrative officers of the institute fully informed of his services to the committee and acted with their full knowledge and approval.

4. It is contrary to the general policy of MIT to permit the use of its facilities for the evaluation of commercial products. Both Dr. Weber and the administrative officers of the institute were aware of the controversial history of the battery additive problem and were, therefore, particularly reluctant to engage in an investigation of this character. It was, however, our understanding that the proposed tests were for the purpose of shedding additional light on technical aspects of the problem and that MIT was not expected to endorse or condemn the commercial value of the product. The request was made by a select committee of the United States Senate and the institute was informed that no funds were available through which the services of a commercial testing laboratory might be engaged. In view of these facts, MIT concluded that it was obligated to place its facilities at the disposal of the committee and Professor Weber agreed to contribute his own services in connection with the tests. A copy of the letter of acceptance addressed on October 9 to Mr. O'Connor is attached.

5. The first suggestion on the part of the committee that additional tests were desirable and that MIT might be asked to undertake them appears to have been made informally at a conference in Washington on September 29, 1952, attended by representatives of the Senate Committee on Small Business, the Post Office Department, the Department of Justice, the Bureau of Standards, and the manufacturer. Dr. Astin was present at this conference and Dr. Weber came away with the impression that Dr. Astin concurred in the usefulness of further tests and that the Bureau would not object to sending an observer in case MIT should agree to perform the work. However on October 21, 1952, the institute was informed by Mr. O'Connor that the National Bureau of Standards did not care to participate. At this time Mr. O'Connor asked that the institute proceed with the tests without participation by the Bureau of Standards.

6. The investigation conducted by Professor Weber and his colleagues was completed early in December 1952 and the contents of the report were discussed with institute authorities. On December 16 two copies of the report were forwarded to the chairman of the Select Committee on Small Business together with a letter of transmittal from Dr. Stratton. This letter points out that no recommendations are included in the report and that it contains no definitive conclusions with respect to the commercial value of the product. A copy of the letter of transmittal is attached herewith.

7. The tests performed by Dr. Weber at the institute were intended to clarify certain questions that had arisen in earlier discussions and to add additional evidence on the behavior of lead-acid storage cells that had been treated with AD–X2. MIT did not agree to evaluate or interpret the tests made by other agencies. Thus, on October 30, 1952, a request was made by Mr. O'Connor that the institute furnish the committee with a brief report on the technical value of test procedures previously conducted by the Navy Department, Bureau of Ships; the Signal Corps Engineering Laboratories; the Chief of Ordnance, Department of the Army; and Wright-Patterson Air Force Base. This request was acknowledged by Mr. M. G. Kispert, executive assistant to the president, on November 6, 1952, with the regret that the institute was unwilling to criticize specific tests by other groups. A copy of Mr. Kispert's letter is attached.

8. Since the institute's services had been performed on behalf of the committee and since our activities had been confined wholly to a set of measurements which were recorded in our report and which we assumed would be made public by the committee in due course, we have acted consistently in the belief that all public statements on the subject should emanate from the committee. The in-

stitute released copies of the report and the letter of transmittal only after they had become public documents.

I would like, if I may, sir, to skip the next 8 or 10 lines, since they are merely an institute statement as to the competency of the people running the institute tests. It will be included in the report, but I don't think they are too important to be read at this time.

The CHAIRMAN. Well, that is entirely your decision, Doctor. As I stated, you may present your statement in any manner you wish.

Dr. WEBER. I wanted to warn you that I am omitting a few lines here.

I would like to read the last part of this paragraph, however.

To the best knowledge and belief of the institute, neither Dr. Weber nor any of his associates received any compensation directly or indirectly in return for their services to the Senate committee nor did they have any financial interests in the product tested or in any similar product.

It is signed by J. A. Stratton, vice president and provost, Massachusetts Institute of Technology, and it happens to be dated April 23, 1953, at Cambridge, because we thought these hearings would occur at an earlier date.

The CHAIRMAN. Doctor, did those lines that you omitted reading pertain to you in person?

Dr. WEBER. They pertain to me in person.

The CHAIRMAN. And that is the reason you did not desire to read it?

Dr. WEBER. That is right; they pertain to me and my associates.

The CHAIRMAN. Fine, sir.

Dr. WEBER. I will make this document a part of my testimony.

(The letters referred to follow:)

UNITED STATES SENATE

SELECT COMMITTEE ON SMALL BUSINESS

JOHN SPARKMAN, ALA., *Chairman*

OCTOBER 8, 1952.

DR. JULIUS STRATTON,
Provost, Massachusetts Institute of Technology,
Cambridge, Mass.

DEAR DR. STRATTON: For the past 3 months, as you know, this committee has been working with the National Bureau of Standards in an effort to determine the merits of a specific lead storage-battery additive known commercially as Battery AD–X2. This additive is produced by Pioneers, Inc., 2411 Grove Street, Oakland, Calif.

As you know, there has been a considerable difference of opinion over the merits of battery additives in general. This committee feels that in fairness to the producers of additives, all of whom are small-business men, as well as in fairness to the motorists using such products, that the question of the efficacy of battery additives should be determined once and for all.

In the opinion of several competent observers, the most recent testing of battery additives at the National Bureau of Standards proved inconclusive. This committee feels that additional tests would be of great help in solving this problem, especially if they were to be carried out in a laboratory which would be capable of taking a fresh approach to the problem.

The purpose of this letter, therefore, is to ask you if it would be possible to have such tests conducted at MIT, using the institute's space and facilities and the necessary personnel. I might say that the reason why the committee has not enlisted the help of a commercial laboratory is because it does not have funds for this purpose.

If MIT could see its way clear to cooperate with the committee in this study, I can assure you that Senator Sparkman, as well as other members of the committee, will be deeply grateful.

With best wishes, I remain,

Sincerely yours,

(Signed) BLAKE O'CONNOR,
Professional Staff Member.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY,
OFFICE OF THE PROVOST,
October 9, 1952.

Mr. BLAKE O'CONNOR,
Professional Staff Member,
Select Committee on Small Business,
Washington, D. C.

DEAR MR. O'CONNOR: Professor Harold Weber, of our Department of Chemical Engineering, has informed me of recent discussions with the National Bureau of Standards on the merits of storage-battery additives and of the specific qualities of the additive produced by Pioneers, Inc., to which you refer in your letter of October 8.

Professor Weber has made it clear that he has no interest in this matter other than that of determining the technical facts and of rendering a public service through your committee. I understand that he has indicated his willingness to undertake a new series of tests in an attempt to resolve the controversial technical points.

I can assure you on behalf of MIT that the institute desires to employ its facilities as fully as possible in the public interest, and we should be particularly pleased to make them available on a problem of concern to Senator Sparkman's Committee on Small Business. Accordingly I have informed Professor Weber that he may draw freely upon our laboratory services and facilities in the course of his tests.

Sincerely yours,

J. A. STRATTON,
Vice President.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

OFFICE OF THE PRESIDENT

NOVEMBER 6, 1952.

Mr. BLAKE O'CONNOR,
Professional Staff Member Select Committee on Small Business,
United States Senate, Washington, D. C.

DEAR MR. O'CONNOR: In Dr. Stratton's absence, I am replying to your letter of October 30, 1952, in which you ask MIT to evaluate four tests that have been made by governmental agencies with Battery AD–X2.

We have considered your request very carefully here at the Institute and have reluctantly concluded that it would be better for us not to criticize specific tests by other groups. We, of course, are very happy to be performing independent tests on the battery additive, the results of which, as you know, will be made available to your committee.

Yours sincerely,

M. G. KISPERT,
Executive Assistant.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

OFFICE OF THE PROVOST

DECEMBER 16, 1952.

Mr. BLAKE O'CONNOR,
Professional Staff Member Select Committee on Small Business,
United States Senate, Washington, D. C.

DEAR MR. O'CONNOR: This airmail letter is to advise you that we have this day transmitted two copies of the report prepared by Professor Harold C. Weber concerning the effect of Battery Additive AD–X2 on lead acid batteries. Following your suggestion we have entrusted these reports to Mr. Goodwin who will deliver them personally to you in Washington.

There are certain points concerning these tests which I should like to emphasize.

We are making the results of the tests available solely to the Select Committee on Small Business. MIT will make no public statement in connection with this investigation.

As you know, this work was undertaken by MIT upon the request of your committee and, while we were reluctant to become involved in a controversial issue, we felt that we should make our facilities available to you in the public interest. All expenses in connection with these tests were covered by MIT. The MIT staff members who worked on the tests received no compensation from any source, and they have no financial or consulting interest in the product tested or in other similar products.

I would point out further that there are no recommendations included in the report, nor did our group arrive at any definitive conclusions with respect to the commercial value of the product. The report sets forth the results of very careful laboratory tests, and these results have been corroborated and analyzed statistically.

Four copies of the report have been prepared, two of which are being sent to you and the other two will remain here at MIT.

Professor Weber has gone to great pains and a considerable personal sacrifice in time to conduct a thorough, competent, and completely nonpartisan investigation of the effects of product AD–X2 on lead acid battery cells. We hope that the report will contribute to the important work of your committee.

Very sincerely yours,

J. A. STRATTON,
Vice President and Provost.

Dr. WEBER. I think, in the interest of brevity and clarity, it might be well if I stated the fundamental differences, if any, between the positions taken here by the Bureau of Standards and myself and the other MIT scientists involved, and I would like to read a statement covering that issue.

It is my opinion that the fundamental difference can be simply stated. The following facts briefly summarize the present status of this question:

1. The Bureau of Standards conducted laboratory tests comparing batteries treated with AD–X2 with others not treated. In a report issued by the Bureau July 11, 1952, covering these tests, it is stated that, and I quote, "No statistically significant indication of any real difference was found between treated and untreated batteries."

2. A set of laboratory tests of a different type from those performed by the Bureau was carried out at MIT comparing treated with untreated cells.

Senator SMATHERS. I did not get that. What was that first point you made? Would you read that over again, please? I did not get it.

Dr. WEBER. Yes.

1. The Bureau of Standards conducted laboratory tests comparing batteries treated with AD–X2 with others not treated.

Am I going too rapidly?

Senator SMATHERS. No; that is fine. I did not know whether you had done this or who had done it.

Dr. WEBER. No; the Bureau.

The CHAIRMAN. There was a little disturbance in the chamber.

Dr. WEBER. Am I reading loud enough?

The CHAIRMAN. You are reading very well. There was a little disturbance in the chamber for just the time you read that sentence.

Senator SMATHERS. He reads clearly and has a fine voice.

Dr. WEBER. I will finish No. 1 again. [Reading:]

In a report issued by the Bureau on July 11, 1952, covering these tests, it is stated that "No statistically significant indication of any real difference was found between treated and untreated batteries."

2. A set of laboratory tests of a different type from those performed by the Bureau was carried out at MIT comparing treated with untreated cells. In these tests statistically significant differences were found between treated and untreated cells. I believe the Bureau agrees with MIT that such differences were found.

3. It is the Bureau's position that, based on these laboratory experiments, AD–X2 is without, and I quote, "beneficial effect on the properties or performance of batteries."

4. It is the position of the MIT group that no conclusions can definitely be drawn as to the commercial utility of AD–X2 or lack of it, based on the MIT experiments, and that the drawing of definite conclusions based on limited laboratory experiments as to the commercial utility of AD–X2 is not justified.

Now, a direct and independent way to determine the commercial utility of AD–X2 as a battery additive is carefully and impartially to examine into the records pertaining to its commercial use.

There is one other matter that I would like to clarify. It has been stated that the MIT tests were not normal tests, normal in the sense of ordinary battery operation, and the chief criticism that had been directed against the tests, as far as my knowledge by attendance of this hearing goes, is that the electrolyte used in the batteries was too dilute, far more dilute than would have been found in normal battery operation.

I would like to quote from page 11 of the printed copy of the MIT report in this connection:

Since the cells chosen for test were sulfated, there was some question as to what electrolyte should be added to the cells. In practically every case, if the cells still contained the original electrolyte—

now, the next word that I should quote is "and" but I am changing that to "with" because I believe the sentence is unintelligible unless I do change that "and" to "with" and so, perhaps, I will go back and reread the paragraph with that "and" changed to "with"—

Since the cells chosen for test were sulfated, there was some question as to what electrolyte should be added to the cells. In practically every case, if the cells still contained the original electrolyte with the sulfate which would be released from the plates on complete charging, a sufficiently high gravity would be attained to meet the manufacturer's specifications. In such cases, only distilled water was added to make up the electrolyte level. Where the cells contained none of the original electrolyte, the general procedure of adding a sulfuric acid-water electrolyte of 1,100 gravity was followed. Had these cells been fully charged, it is quite probable that eventually the gravity of the electrolyte would have exceeded the manufacturer's specifications, and it would have been necessary to withdraw electrolyte and substitute distilled water. In none of the tests was charging carried far enough to make such an adjustment necessary.

Now, you will note the paragraph says that the general procedure was——

Senator SMATHERS. Mr. Chairman, may I ask a question?

The CHAIRMAN. At the commencement of these hearings I expressed a hope that the committee would permit Dr. Weber to make his total

statement, and then we would proceed to question him, because the first day's experience was that the questions came from everyone and the statement was never completed, and that is the reason why I would like to defer all questions.

Senator SMATHERS. I just have one question which I think would help all of us understand you. When you say "manufacturer's specifications" you mean the manufacturer of AD–X2 or the battery manufacturer?

Dr. WEBER. No, I meant the battery manufacturer's specifications.

Senator SMATHERS. That is all I wanted to ask—the battery manufacturer.

Dr. WEBER. The statement I have just read says that the general procedure was—there was one exception to the general procedure. There was 1 battery made up of 4 cells which we made by sawing apart a single cell, hoping to get 4 smaller cells of more uniform past history in that way. That was rather early in the experimental work, and it is true that, in that 1 battery of 4 cells which we made up that way, distilled water only was added, and that is so stated in the report.

There were 26 cells to which we added 1.100 acid, and of all the cells tested, 56, I believe, some of which had to be discarded, the others had enough original electrolyte so we were in a quandary as to what to do, and to those we added distilled water to bring the liquid up to the proper level.

I feel quite sure that the procedure is quite normal in the charging of a storage battery. That is all I have to say, Senator.

The CHAIRMAN. That completes your statement?

Dr. WEBER. That is correct; yes, sir.

The CHAIRMAN. Doctor, in order that we may have a better record of your qualifications, what year did you finish college?

Dr. WEBER. I graduated from MIT with a bachelor's degree in 1918, but because of my war service the degree was not awarded to me until 1919.

I received a doctor's degree from the Swiss Federal Institute at Zurich, Switzerland, in 1935.

The CHAIRMAN. You majored in what?

Dr. WEBER. I majored in applied chemistry.

The CHAIRMAN. You have been an instructor in that field as a college professor for how many years?

Dr. WEBER. Since 1921.

The CHAIRMAN. 1921?

Dr. WEBER. That is correct.

The CHAIRMAN. Your present position with MIT is what?

Dr. WEBER. My present position is professor of chemical engineering.

The CHAIRMAN. You ran a test on those batteries to satisfy yourself that the product either had some beneficial effect on the battery or did not. After you had completed this test, were you satisfied that you had done everything within your power and within your ability to give the product a fair test?

Dr. WEBER. I certainly did.

The CHAIRMAN. It was your confirmed opinion that the product did have a beneficial effect on the battery?

Dr. WEBER. I would like to quote from the report in answering that question. Dr. Stratton, in the letter of transmittal which accompanied the report, commenting on the report says:

I would point out——

The CHAIRMAN. Before you commence, Dr. Weber, let us have a history of Dr. Stratton.

Dr. WEBER. I am not sure how much of a history I can give you of Dr. Stratton. Dr. Stratton is a physicist who was formerly a professor, I believe, in the physics department at MIT, but now is the provost or vice president of the Massachusetts Institute of Technology. He is the second highest ranking administrative officer.

The CHAIRMAN. He is the second highest ranking administrative officer of MIT?

Dr. WEBER. That is right; he comes after the president.

The CHAIRMAN. And this is his report?

Dr. WEBER. No; the report is the report that I made and has been referred to so often as the MIT report.

The CHAIRMAN. Yes. It is a report that Dr. Stratton released on the MIT investigation?

Dr. WEBER. No; this is the letter of transmittal which accompanied the report on the MIT investigation.

The CHAIRMAN. I see. You may then continue.

Dr. WEBER. I thought it would be pertinent to add his remarks concerning the report, as well as my own, which I will read from the report.

The CHAIRMAN. Fine, sir.

Dr. WEBER (reading):

I would point out further that there are no recommendations included in the report, nor did our group arrive at any definitive conclusions with respect to the commercial value of the product. The report sets forth the results of very careful laboratory tests, and these results have been corroborated and analyzed statistically.

The CHAIRMAN. Did that complete your statement?

Dr. WEBER. No; I have others I would like to read.

The CHAIRMAN. Well, we will wait until you find them.

Dr. WEBER. On the first page of the report on the recommendations, "None, since the purpose of this work was to establish facts."

I thought I had these all marked yesterday.

The CHAIRMAN. Doctor, you have been present at these 4 days of hearings, have you not?

Dr. WEBER. Yes.

The CHAIRMAN. We are trying to determine whether this product has merit or not.

Dr. WEBER. Yes.

The CHAIRMAN. I will say further, Doctor, that I have absolutely no interest in the product, only as a Member of Congress who is trying to determine whether a businessman should have an opportunity or whether that opportunity should be denied the businessman, because of a finding of a Federal agency.

In your opinion, are laboratory tests the final word in testing such a product as a battery additive?

Dr. WEBER. No. I would like to read you a section from the report that discusses that particular point. At page 10, a special paragraph was inserted in the report, and I would like to quote that paragraph:

LIMITATIONS OF LABORATORY RESULTS

The difficulty of duplicating in the laboratory results obtained in the field is well recognized in engineering work. The laboratory evaluation of a material such as AD–X2 is further complicated by the great variation in the samples subjected to tests, even though every effort be made to so select test units as to minimize such variation. Usually, an evaluation of how a product will act under field conditions can be obtained only after extensive laboratory experimentation. Even after such experimentation, it is common practice in engineering work to subject products to field tests. How a given innovation will perform under use conditions is the true test of its worth. For this reason, laboratory findings must be supplemented by field-use data if a true evaluation is to be obtained.

The CHAIRMAN. In other words, after a test has been run on a battery for, say, several weeks, if you were to take the battery down and examine the plates specifically with your scientific knowledge of the battery-plate construction, you do not think that you could read from what you see on the plates all the effects, whether they be beneficial or detrimental to that battery construction—you do not think you could read it all from a laboratory test?

Mr. WEBER. I think it would be dangerous to.

The CHAIRMAN. You say it would be dangerous?

Dr. WEBER. Yes.

The CHAIRMAN. What do you mean by "dangerous," as an injustice to the manufacturer or an injustice to the scientific field on the basis that you may arrive at wrong conclusions?

Dr. WEBER. On the basis of the scientific conclusions, because you won't be sure you have run all the laboratory tests of the different types that should have been run to have duplicated the use conditions.

The CHAIRMAN. Do you think it is possible for a product to fail in the laboratory test and still be successful in the field, in the desulfation of the battery?

Dr. WEBER. I didn't get the last part of your question.

The CHAIRMAN. The question is, Do you think that it would be possible for the product really to fail in the laboratory test and still have some beneficial effect on a battery in its regular normal field operation?

Dr. WEBER. I would think that would be possible.

The CHAIRMAN. You think it could be possible?

Dr. WEBER. It could be possible. In fact, some of the results I have obtained, I believe, can be interpreted either as benefits or not.

The CHAIRMAN. Well, one of the injurious things to a storage battery is the fact that a battery will become sulfated. Understand now, I know nothing about a battery, but I have listened to the technical explanations, and from what I have read, a battery becomes highly sulfated; that has a deteriorating effect on the battery. It has a tendency to break a battery down so that the cells in it do not perform as well as if that battery were not in a high state of sulfation.

Do you think that in a laboratory test you might not discover such sulfation in a period of, say, a few weeks, whereas out in the field, in a period of months, under a constant operation, with an intake of electrical current from the generator and a giveoff to the mechanism that it is furnishing electricity to, that you would find the battery becoming sulfated?

Dr. WEBER. Well, certainly if the laboratory tests were not of the proper type to detect the sulfation, you certainly wouldn't detect it

in the laboratory; and it might be that, even if the tests were of a type that you thought would detect sulfation, you still might not detect it in the laboratory.

The CHAIRMAN. Do you think then that it is highly desirable not only to have a laboratory test but to go out and take an extensive test in the field so that you would have information of the effects in the normal operation of the battery in the field, to supplement or to check that against the findings in the laboratory?

Dr. WEBER. Yes, unless the laboratory investigations were very complete and very searching.

The CHAIRMAN. It was your impression that the Bureau of Standards would cooperate in the MIT test, is that correct?

Dr. WEBER. It was my impression, although in fairness to Dr. Astin, he said he would, I think as I remember it, he said he would not object to sending an observer to the MIT tests.

The CHAIRMAN. Did they?

Dr. WEBER. Did they object?

The CHAIRMAN. No, did they send an observer?

Dr. WEBER. They did not send an observer.

The CHAIRMAN. Was Mr. Ritchie present?

Dr. WEBER. Mr. Ritchie was present at a great many of the MIT tests.

The CHAIRMAN. He was present at a great number of them?

Dr. WEBER. Yes.

The CHAIRMAN. Did you follow Mr. Ritchie's recommendations as to how to use the product?

Dr. WEBER. I followed his recommendations as given on the printed package as to how to use the product.

The CHAIRMAN. You followed that?

Dr. WEBER. Yes.

The CHAIRMAN. How many cells did you have or how many batteries did you have in this test?

Dr. WEBER. I think my report shows there were 56 altogether.

The CHAIRMAN. Fifty-six batteries altogether?

Dr. WEBER. Fifty-six cells.

The CHAIRMAN. Fifty-six cells. Normal three-cell batteries?

Dr. WEBER. Some of them were 2 cells and some of them were 4 cells. You see, I rearranged the cells in order to get more precise measurements, so that some of them were 2-cell batteries, some of them were 4-cell batteries, a few were 3 cell.

The CHAIRMAN. So you possibly used, roughly, somewhere between 15 and 20 batteries?

Dr. WEBER. Something like that; yes.

The CHAIRMAN. Over how long a period of time did you run this test?

Dr. WEBER. That is a matter of record from the report before you, but it was, I think as I remember it, something in the order of between a month and 2 months.

The CHAIRMAN. Nearer 2 months?

Dr. WEBER. It was nearer 2 months than 1 month; it is a matter of record in the report.

The CHAIRMAN. Would you have liked to have gone further with your tests and gone into the field and observed batteries under normal field operations?

Dr. WEBER. I must interpret the word "like," and I would say "no," from the point of view of time and energy, but "yes" from the point of view of scientific interest.

The CHAIRMAN. I realize, Doctor, that you could not very well conduct it, but, as a man who is interested in the question, would you have liked the opportunity to have gone into the field and gotten some field data on the question?

Dr. WEBER. I would have hoped that by so doing I might have been able to give a more definite answer than I have, and I certainly would have liked to.

The CHAIRMAN. Had you had any experience with the product before you ran the test in the MIT laboratory?

Dr. WEBER. Yes, I had had some experience with it. It is a very indefinite experience. I had run a few preliminary tests, 10 in fact, which are included in the MIT tests, in order to obtain some familiarity with how the material would react, before I went down and discussed with Dr. Astin and his group the Bureau of Standards July tests. Before that I had performed some unscientific, uncontrolled experiments just to sort of get a feel of what the material would do.

The CHAIRMAN. Did you find that as you proceeded with it you got a more positive fact out of your search as you used several batteries? Did you find any material difference from one battery to the other while you were observing the effects of them?

Dr. WEBER. Yes, those are the eight differences which I have noted in the report.

The CHAIRMAN. That is, you found 8 differences on 1 battery?

Dr. WEBER. No; on all of them; this is all.

The CHAIRMAN. Would you have been satisfied that you had satisfied your own scientific curiosity by just testing, say, one battery?

Dr. WEBER. No.

The CHAIRMAN. You would not have been satisfied that you had satisfied your scientific curiosity?

Dr. WEBER. Not at all.

The CHAIRMAN. Your scientific curiosity was still searching, even when you had run the tests on the 18 batteries?

Dr. WEBER. Yes, consisting of the 56 cells.

The CHAIRMAN. Doctor, I wish I were a scientist right here this morning, because then I could intelligently ask you questions. But I am not a scientist and, therefore, I cannot ask intelligent questions in order to draw all of this out, but you have for a great many years been in that scientific field, either as a professor teaching it or searching to improve the storage battery, and you heard the testimony of these two men who just knew the physical labor in a battery shop, so to speak, or have supervision over it as supervisors; and these gentlemen thought that the product had a benefit in prolonging the life and efficiency of a battery.

Would you be willing to challenge any of the statements that those two men made last night, speaking as civilian employees of the military forces?

Dr. WEBER. I would neither challenge nor agree with the statements because I would first want to carefully and impartially examine the records pertaining to this commercial use.

Don't misunderstand me, I have the utmost respect for practical experience, but practical experience, of course, needs to be interpreted.

The CHAIRMAN. Not being an expert in the field, I could only take their testimony and weigh it in a practical manner.

The reason I asked you the question was you are qualified technically to pass an opinion on their statement, and I was just searching for confirmation of their statements by asking you that question. You would want to have further knowledge of the details of that battery history?

Dr. WEBER. That is right. I certainly would not discount their testimony before I had had a chance to examine the conditions.

The CHAIRMAN. Do you use it in your own car?

Dr. WEBER. Yes; I do.

The CHAIRMAN. You use it in your own car?

Dr. WEBER. I paid for the package I am using in my own car, too.

The CHAIRMAN. Then, Doctor, what is your personal experience?

Dr. WEBER. Well, scientifically I don't have any personal experience. The material was put in the battery a year ago, the battery has performed in a perfectly normal manner ever since. I have put water in the battery once in 11 months, but other than that I have had——

The CHAIRMAN. How old was the battery?

Dr. WEBER. The battery was new when I put it in. I put it in a new battery.

The CHAIRMAN. In other words, you were going to start right out with the full benefit and effect of it?

Dr. WEBER. Well, you can tell very little, of course, from one battery, but my feeling was that it isn't supposed to make a new battery any better, but it is supposed to keep a new battery in new condition longer than would otherwise be the case, and that is what I am trying very roughly to find out.

The CHAIRMAN. In other words, Doctor, you say in 11 months you have not added water?

Dr. WEBER. At the end of 11 months I added water to the battery.

The CHAIRMAN. It is customary for a battery to use more water than that.

Dr. WEBER. That is correct, and I am a little impressed with that, but don't be misled by one experiment.

The CHAIRMAN. The only reason I asked the question is just to see whether your curiosity was sufficiently aroused to experiment with it personally.

Those are the only questions that I have. As I stated before, I wish that I were a scientist. I want to say to the press, particularly, that I have appreciated the public information that you have given out. Some of you hit only that which was sensational, and others went more into the report, but there is a great concern, both in the scientific field and in the ordinary public opinion on this question. If this hearing accomplishes anything at all, it will, at least, be that we will bring the scientific, as well as the practical, experience out into the open where the public can take hold of it.

Should we ask the people who use AD–X2 if it is effective or of any benefit to them in trying to determine what the final decision should be relative to the fraud order that is now in suspense over the manufacturer?

Dr. WEBER. As I stated before, I never discount the practical man's experience. I have a deep respect for practical experience, but practi-

cal experience, of course, always must be weighed in the scientific balance before it can be accepted as true scientific data.

The CHAIRMAN. You must add them all?

Dr. WEBER. You must not do so much adding as you must do analyzing.

The CHAIRMAN. Of course, when they first conceived the steel moldboard plow, they said it would never work.

Dr. WEBER. That is correct.

The CHAIRMAN. But it revolutionized agriculture when it worked.

Dr. WEBER. Theoretically, a storage battery does not work.

The CHAIRMAN. You say theoretically a storage battery does not work?

Dr. WEBER. I say theoretically a storage battery doesn't work. If you don't take recourse to any practical experience, the storage battery doesn't work.

The CHAIRMAN. Doctor, would you give us an explanation as to why a scientist can argue in that manner? Would you give us a scientific explanation of why a scientist might argue both sides of the question?

Dr. WEBER. Well, I don't like to bore you with scientific explanations, but a scientist might, if he had no practical experience, try to calculate the voltage that would be developed by a lead-acid battery in terms of tables of so-called electrode potentials, and he would find that you couldn't get as high a voltage from a lead-acid battery as you do. That is due to another effect, which is a variable effect, not too well understood, and would be explained one way by one group of scientists, perhaps another way by another.

The CHAIRMAN. But it does work?

Dr. WEBER. It does work; it is like the bumblebee that can't fly.

The CHAIRMAN. Well, I will yield or I will turn to Senator Sparkman. Senator Sparkman was chairman of this committee at the time that this question was submitted to MIT. There has been some question raised as to why a staff member submitted the report, the staff member being Mr. O'Connor.

Well, both Senator Sparkman and I served on that committee last year.

The situation arose during the recess of the Congress when members of the committee were away from Washington. Therefore, the committee staff was entrusted with the duty of assisting small-business men over the country who brought their problems to the committee's attention.

So do not criticize Mr. O'Connor or any of the staff, because they were performing their duty. I think that Senator Sparkman would not challenge that statement of mine.

Senator Sparkman?

Senator SPARKMAN. Dr. Weber, since you are giving some scientific explanations—I have heard that bumblebee thing brought up twice. I do not know what it is about; I never heard that a bumblebee could not fly. Can it or not?

Dr. WEBER. Practically, it can; yes.

Senator SPARKMAN. I thought so. Why do we argue it cannot then?

Dr. WEBER. I think there were some earlier theories developed, and this is entirely out of my field.

Senator SPARKMAN. It is just off balance. I will not ask you to go further.

Tell me this: How did AD–X2 first come to your notice? How did you happen to get it? I gather from what has been said here that you were working with it on a small limited basis, I think you said uncontrolled, even before the committee brought you into it?

Dr. WEBER. Several years ago—I don't know how many, 4 or 5 years ago—I had been interested in battery addities ever since I can remember, and I had run into many during my lifetime, but they were usually additives that were put out by people with no scientific backing, and usually claims were made which could be disproved theoretically—in spite of what we said about the theory this morning, these claims could be disproved theoretically.

It was about 4 or 5 years ago, I believe, that a very small news item appeared in either Industrial Engineering and Chemistry or the News Edition—those are both American Chemical Society publications—I am not too sure of that, but I think it was there—pointing out that Dr. Merle Randall was associated with a battery additive.

I never knew him personally, but I certainly knew of his reputation through the years, because of his association with G. N. Lewis, and because Dr. Randall worked in the same field, the same field I had worked in. This attracted my attention, and I wrote to the suggested address, Pioneers, Inc., and received some literature on AD–X2, and it looked interesting, but I sort of forgot about it. There are other things that are much more important.

The next contact I had was when Mr. Goodwin, the local agent, sent me some literature on AD–X2. I don't know why he sent it to me. I accused him of going back into Pioneers' file and finding my original letter of several years previous, but he says, no, he had no record of that, so it couldn't have been that. I don't know how he got hold of me unless it was because my interest in electronic and electrical things, as well as in chemical engineering, is fairly well known around Boston.

Spurred on by curiosity I went out to Mr. Goodwin's business establishment and bought some of the stuff. He still reminds me that I said it was no good when I bought it.

Senator SPARKMAN. Is Goodwin the local distributor?

Dr. WEBER. That is the local distributor in Boston.

Senator SPARKMAN. In your community?

Dr. WEBER. Yes.

Senator SPARKMAN. Had you known him?

Dr. WEBER. No, I never knew him before; I never knew anything about it. I never had met the man and never had even heard of him.

Senator SPARKMAN. In other words, neither he nor Pioneers nor Mr. Ritchie approached you; you went and bought it out of your scientific curiosity?

Dr. WEBER. That is right.

Well, Goodwin sent me the literature. Suddenly, out of a clear sky, this literature appeared on AD–X2. Then I remembered that was the stuff I had heard of several years before, and my curiosity was aroused, and I went out and bought some of it. That is the material that I used in most of those—I think in all of those—preliminary 10 experiments, and these practical experiments that I have been running.

Senator SPARKMAN. Talking about the things that scientists have said are impossible and would not work, are you familiar with the automatic firing mechanism of the Navy?

Dr. WEBER. I have heard of that. I understand that is another one that it was claimed would not work, but, as a matter of fact, when it was tried, did.

A very interesting episode of that type was related to me by the previous head of the mathematics department of MIT one day when we were discussing such things. He said he still remembered as a student leaving a lecture hall after a physics lecture where the professor had just proved conclusively that it would be impossible to send a radio message across the Atlantic Ocean. He said that, as they left the lecture hall, the newsboys met him with the report that Marconi had just done it.

Senator SPARKMAN. I am not sure that I am clear on what you said about field tests. Do you believe that in connection with these tests on the batteries a field test would be necessary before you came to a definite conclusion?

Dr. WEBER. As far as I am concerned——

Senator SPARKMAN. Well——

Dr. WEBER (continuing). Or in general?

Senator SPARKMAN (continuing). So far as you are concerned or so far as you would be willing to vouch whether or not the thing worked one way or another.

Dr. WEBER. Now, remember, I am only familiar with the July——

Senator SPARKMAN. Let me state the reason I asked the question. I understood you to say a while ago—and I may be mistaken—that laboratory tests within themselves might not be complete.

Dr. WEBER. Might not be sufficient; that is correct.

Senator SPARKMAN. Might not be?

Dr. WEBER. Might not be.

Senator SPARKMAN. Did you intend by that that they need to be supplemented by field tests?

Dr. WEBER. Often they need to be supplemented by field tests.

Senator SPARKMAN. In this particular case?

Dr. WEBER. I would like to base my answer on what I know about the July Bureau of Standards' test, July 1952, and the MIT tests.

I made no study, no serious scientific study, of the other information, but based on those two tests, I would want to see some field data before I said the material was of no value.

Senator SPARKMAN. Do you have any other comment to make upon the manner in which the Bureau of Standards conducted its tests?

Dr. WEBER. No. At the meeting that we held, Dr. Astin and I had what I thought was a very amicable scientific discussion—it might not have sounded so to some who were present, because scientists get quite heated about some of the defects or some of the differences of opinion. They weren't defects, they were differences of opinion, as to how some of the measurements were made, and I did present my 10 preliminary experiments which were the first controlled experiments I had run, and it was agreed that they were rather small in number, and that was the basis on which it seemed as though more tests were necessary at that time.

Senator SPARKMAN. That was your preliminary test?

Dr. WEBER. That is correct.

Senator SPARKMAN. You said yourself you did not feel that was sufficient?

Dr. WEBER. No. Naturally, I argued for the value of my tests when I went down to talk to Dr. Astin.

Senator SPARKMAN. How many cells did you use in your final test?

Dr. WEBER. There were 56 altogether, but that included the 10 that were reported on in the preliminary test.

Senator SPARKMAN. In other words, you combined the 10 in the preliminary with 46 in the final test?

Dr. WEBER. That is correct; that is so stated in the report.

Senator SPARKMAN. Have you read the criticism—I think that is a correct term—that was directed toward the MIT test in, I believe, a statement that the Bureau of Standards put out? Did you read that?

Dr. WEBER. I may be wrong; I don't think it was a criticism; it was a difference of opinion.

Senator SPARKMAN. I thought I might be using the wrong word.

Dr. WEBER. It was a difference of opinion, wasn't it?

Senator SPARKMAN. That is the reason I hesitated when I said "criticism." Let us say the statement dealing with the MIT test.

Dr. WEBER. I think it was. Yes, I read that in the publication of the American Chemical Society.

Senator SPARKMAN. One of them you pointed out was about the use of a diluted mixture, too diluted, I believe that was.

Dr. WEBER. That is a difference of opinion that you are quoting from what I have said.

Senator SPARKMAN. Well, you explained that?

Dr. WEBER. Yes.

Senator SPARKMAN. Was there any other criticism in that or in your conversation with Dr. Astin—was there any other criticism?

Dr. WEBER. We have discussed what was meant by a normal test. To me that has always been a little beside the point, because oftentimes in laboratory experiments you devise an abnormal test to try to prove something, and I—don't misunderstand me; I am not admitting that my test was abnormal in any respect—but, even if it had been, I don't see how it would have been too pertinent to the argument.

Senator SPARKMAN. Doctor, I have been rather of the opinion that when you make tests of this kind you set up several different conditions; is that correct?

Dr. WEBER. I think you should. I think you should set up as many different kinds of conditions as possible in order to collect as many facts as possible on which to base a conclusion.

Senator SPARKMAN. Do you feel that your tests did that sufficiently?

Dr. WEBER. Well, I used several different kinds of batteries, different types of batteries.

Senator SPARKMAN. You mean batteries in different condition?

Dr. WEBER. No; they were in different condition, naturally, but I used batteries that were made for different purposes. I had some airplane batteries; I mentioned the battery we made ourselves from a larger battery; I had some automobile batteries; so that there was that variation of the kind of batteries used. Now, pretty much the test that I used was to a very great extent, I would say, roughly the same kind of test on each cell.

Senator SPARKMAN. Let me say this: It has seemed to me rather strange that of all of the tests that have been made of this additive, there is some criticism of them. One side criticizes or the other side criticizes.

Now, I asked Dr. Astin this question the other day: Is it not possible to devise a test that can be agreed upon by all, so that, if it is run, it will be foolproof?

Dr. WEBER. Well, I, at least, hoped we were going to run one at MIT that was agreed upon by all. I don't know whether it would have been foolproof or not.

Senator SPARKMAN. But the Bureau of Standards declined to participate?

Dr. WEBER. That is correct.

Senator SPARKMAN. Did you go over with the Bureau of Standards the tests you proposed to make?

Dr. WEBER. We never got that far. They certainly knew the kind of test I had made on the first 10 experiments because I had reported that rather completely, and offered them my data on those tests. They never did get the data, but it was verbally offered and later an offer was made in writing.

Senator SPARKMAN. This committee from the Academy of Sciences that is being appointed or has been——

Dr. WEBER. I don't know whether it has been appointed or not.

Senator SPARKMAN. You do not know whether it has been or not. Would you feel that that committee could review these tests and determine whether or not they had been adequate and also whether or not the conclusions drawn from them were properly drawn, or, if not, could that committee work out a series of tests that would be conclusive?

Dr. WEBER. I have every reason to believe that the National Academy will thoroughly examine the questions, and I have every reason to believe they will examine not only the laboratory data but the practical data, and I certainly have confidence that they will render as good a decision as such an eminent group of scientists could render. I think they may be able to devise a laboratory test; I wouldn't say they couldn't.

Senator SPARKMAN. Do you believe that consideration should be given to the testimony of such persons as Senator Thye, the chairman, referred to a few minutes ago, these people who have used this material over a long period of time?

Dr. WEBER. As a practical engineer, I have been fooled too many times by not paying attention to what people of that type say, and I certainly would listen carefully to what they had to say, and then try to rephrase or reanalyze their findings in terms of the usual scientific data method. I certainly would want to consider their experience.

Senator SPARKMAN. Of course, I do not see how a layman can very well disregard it. It is bound to make some impression in the mind of a layman.

Dr. WEBER. A scientist can't completely disregard it, it seems to me, particularly in a case like this.

Senator SPARKMAN. That is all, Mr. Chairman.

The CHAIRMAN. Senator Gillette?

Senator GILLETTE. Mr. Chairman, I should like to ask one question off the record.

(Discussion off the record.)

Senator GILLETTE. On the record, Mr. Chairman.

I have said here before, Dr. Weber, and I repeat, that I have no knowledge and little interest as to whether the one test or another shows the particular merchandise to be valuable or not, relatively; but I am tremendously interested if any agency of this Government, the Bureau of Standards, the Federal Trade Commission, the Post Office Department, or any other agency, has been, wittingly or unwittingly, knowingly or unknowingly, used to impair the business and the business position of any citizen of the United States.

In your testimony you called attention to a meeting that was held in September 1952, and I read from a memorandum that the chairman has made available to the members of the committee, and I shall ask if this accords with your memory:

On September 29, 1952, in the afternoon, a meeting was held in Dr. Astin's office, attended by several members of the Bureau of Standards' staff, representatives from the Post Office Department, Mr. Ritchie, Dr. Weber, Dr. Laidler, and Blake O'Connor. After a long discussion of the problem it was agreed that additional tests of AD–X2 would be desirable; that preferably such tests should be held elsewhere than in the Bureau of Standards, and that the Bureau would agree to participate in such test.

To the best of your recollection, is that a correct statement?

Dr. WEBER. I think I have—with the exception that I said Dr. Astin did not agree, he just used some sort of phraseology: "It would not be objectionable" or "It could be arranged" or something of that sort. It was not agreed.

Senator GILLETTE. That is, you say there was no formal agreement?

Dr. WEBER. It was not a formal agreement. I certainly left with the impression that more tests would be run.

Senator GILLETTE. That is the point; from the discussions that were had there, there was no expression of disagreement.

Dr. WEBER. No; none at all.

Senator GILLETTE. Or refusal to conform to such a test?

Dr. WEBER. The only expression of disagreement was my expression, I think, that I didn't want to have to run the tests.

Senator GILLETTE. Well, now, this memorandum further says:

That on September 30, 1952, Blake O'Conor—

of our staff here—

wrote to Dr. Astin suggesting that, in view of the conflicting technical evidence on AD–X2, it might be fair to the small business involved if Bureau literature critical of AD–X2 was not circulated, pending a reconciliation of the conflicting technical points of view. On October 8 Blake O'Connor wrote Dr. Julius Stratton, provost of MIT, asking if it would be possible for the tests agreed upon to be conducted by MIT as a public service and at no expense to the committee. The following day, October 9, Dr. Stratton agreed to have MIT conduct the agreed-upon tests.

Now, October 30—that was 10 or 11 days after—

Blake O'Connor was informed by Dr. McPherson, assistant to Dr. Astin, that the Bureau would take no part in the tests to be conducted at MIT.

In view of those memoranda that I have quoted, when did you first receive any information that the Bureau of Standards would not participate in any way in these tests?

Dr. WEBER. I believe there was a letter from—I believe that my first information that they would not run the tests was a letter from Mr. O'Connor. I am not quite certain whether it was a letter to me or to Dr. Stratton, but it was one either to Dr. Stratton or to me.

Senator GILLETTE. Do you have any independent knowledge or any memorandum from which you can fix that date that you first heard——

Dr. WEBER. Yes; I think I have here. It was on October 8 that Mr. O'Connor wrote me asking whether facilities for conducting the required laboratory tests on AD–X2 might not be made available at MIT, and asking for my help in making additional tests of AD–X2.

Senator SMATHERS. What was that date?

Dr. WEBER. That was October 8, according to my chronological record.

The CHAIRMAN. What year?

Dr. WEBER. 1952.

Senator SMATHERS. Asking you to participate?

Dr. WEBER. Yes, asking for my help in making additional tests.

On October 21, 1952, according to my chronological record, there was a copy of a letter written by Blake O'Conner to Dr. Stratton informing us that the NBS did not propose to participate in the proposed test at MIT, and Mr. O'Connor asked us to conduct the subject tests unilaterally.

Senator GILLETTE. The only point I wanted to develop for the record at this point was that on September 29, next to the last day of September, at a meeting at which representatives of the Bureau of Standards, your group, and this committee met and discussed the question of additional tests, so far as you know, there was no disagreement as to the advisability of conducting those tests?

Dr. WEBER. No; there was, so far as I know, none.

Senator GILLETTE. And the first information that you had that the Bureau of Standards did not care to participate in these tests was when you were informed by Blake O'Connor—I do not know whether you received this actual information, but this memorandum states on October 20 that Dr. McPherson, of the Bureau of Standards, informed Mr. O'Connor that they would take no part. Did that information come to you?

Dr. WEBER. Yes. I am not sure but what Mr. O'Connor might have called me on the telephone, but I have no record of that at that time.

Senator GILLETTE. At any rate, you received no word yourself directly from the Bureau of Standards or anyone representing them?

Dr. WEBER. No; I received no word from the Bureau.

Senator GILLETTE. That is all, Mr. Chairman.

The CHAIRMAN. Off the record.

(Discussion off the record.)

The CHAIRMAN. Senator Smathers?

Senator SMATHERS. Thank you, Mr. Chairman.

Dr. Weber, let me say that I have a great respect for any man who can graduate from such a school as MIT, and certainly one who does such a good job there that he can subsequently become a professor.

Secondly, I am going to question you about a lot of things that I, frankly, do not know too much about, so if my questions do not make too much sense to you, why, stop me and start me over again.

As the other Senators have said, we are interested in seeing that no businessman gets put out of business arbitrarily. I think we are also

interested in seeing that no consumer gets sold something under representations that do not measure up. So we have sort of a dual responsibility not only of protecting the businessman but also, possibly, the consumer.

Doctor, do you consider the National Academy of Sciences committee which has been selected to test this battery additive AD–X2 a competent committee to resolve this problem?

Dr. WEBER. I do not know whether they have been selected or not, but I feel very sure that the committee that will be selected will be competent to do it.

Senator SMATHERS. I will not attempt to read the names; apparently they have been selected.

Dr. WEBER. I did not know they had been.

Senator SMATHERS. But it is your opinion that it will be a competent committee, and you will be willing to abide by the decision which they finally come up with?

Dr. WEBER. Yes; it will be a competent committee, and if they carefully examine not only the laboratory——

Senator SMATHERS. If they what?

Dr. WEBER. If they will carefully examine not only the laboratory but all of the field data in the report, then I will be pretty well satisfied. You can see my reluctance as a scientist in committing myself to something like that before I know what is going to happen, what it is going to be, except in terms of the standing of the men who will do the work.

Senator SMATHERS. But, assuming that they conduct tests as thoroughly as done by MIT or the National Bureau of Standards, then that will be satisfactory with you?

Dr. WEBER. I should hope they would be much more thorough than the MIT tests.

Senator SMATHERS. You do not mean the MIT tests were not so very thorough, do you?

Dr. WEBER. I don't know whether they covered enough ground.

Senator SMATHERS. You do not think the MIT tests could pass real judgment on the value of this AD–X2?

Dr. WEBER. I stated facts in my report.

Senator SMATHERS. You have so stated?

Dr. WEBER. In my report.

The CHAIRMAN. Then this likewise will be a fair question: Did you feel that the Bureau of Standards had run a sufficient test to likewise make a final decision on the question?

Dr. WEBER. No; I didn't feel that, based on the July 1952 report, which is the only report of the Bureau that I studied to any extent—I was not satisfied that they were entitled to make the definite conclusion that the stuff was of no value.

The CHAIRMAN. You were not satisfied that they should make a definite conclusion on what tests they had run?

Dr. WEBER. Based on the report of July 1952 alone. I am not including any other tests they had made.

The CHAIRMAN. And your own scientific curiosity is such that you would like to see a more extensive test run on the product before a final decision is made on the question?

Dr. WEBER. Yes, sir. That is the understanding, of course, with which I undertook this rather long and laborious series of tests.

The CHAIRMAN. I am sorry for the interruption, Senator.

Senator SMATHERS. That is perfectly all right.

Now, if you say that the tests at MIT were such that you cannot deduce either that AD–X2 was good or bad, then that sort of makes all my other questions purposeless.

Dr. WEBER. Facts are stated in the report, Senator.

Senator SMATHERS. I notice on page 25——

Dr. WEBER. Is that the one I was looking for?

Senator SMATHERS. Dr. Beattie states, "I cannot say that this effect is correlated with a beneficial action from the standpoint of the normal use of such a battery."

Dr. WEBER. That is correct.

Senator SMATHERS. Did you agree with that?

Dr. WEBER. Oh, I absolutely agree. In other words, he says, "I don't know whether it is good or bad."

Senator SMATHERS. In other words, anybody who may have interpreted the MIT report as being favorable to AD–X2, was reading something into the report that you and Dr. Beattie did not see in it?

Dr. WEBER. Well, they were drawing a conclusion we did not draw.

Senator SMATHERS. They drew a conclusion which you did not draw and with which you do not agree?

Dr. WEBER. I must say that I have never been able to read into the MIT report an unfavorable effect for this material.

Senator SMATHERS. You are the author of that report, are you not?

Dr. WEBER. That is correct.

Senator SMATHERS. Did you intend to write a favorable or an unfavorable report?

Dr. WEBER. I tried to write an unbiased report.

Senator SMATHERS. An unbiased report. Well, let me ask you just a couple of questions. As I say, in view of your statement here, I do not think that many of the questions that I had ready are of much purpose. But let me just ask you this. What has been your experience in battery work?

Dr. WEBER. This may not sound pertinent to your question, but I think it is for background. My chief field of interest over many years has been thermodynamics, and thermodynamics is fundamental to a study of batteries. It is the field in which Dr. Randall attained so much prominence, too.

Senator SMATHERS. Who were the outstanding American authorities on storage batteries? Could you name some of them?

Dr. WEBER. Dr. Vinal's book is very well known, and Dr. Vinal would certainly be classed as an outstanding authority.

Senator SMATHERS. Would Dr. Vinal be considered in the top five on this matter of storage batteries?

Dr. WEBER. I don't know. I would say this. His name is very well known everywhere. When you mention storage batteries, you think of Dr. Vinal.

Senator SMATHERS. Do you know of anybody else whose name comes to you more quickly or readily than that of Dr. Vinal when you are dealing with storage batteries?

Dr. WEBER. No; because I think his is the first book on storage batteries I ever read, many, many years ago.

Senator SMATHERS. There is one question I would like to get cleared up. As I gathered from your answer to Senator Gillette's question, you sat in a meeting over in Dr. Astin's office, I think it was, September 29, 1952?

Dr. WEBER. That is correct.

Senator SMATHERS. And at that time, MIT had not been brought into this particular problem of examining these batteries?

Dr. WEBER. Well, at that time—previous to that time, Mr. O'Connor had asked me as a public service if I would aid the committee in attempting to evaluate this product. And I had been doing that with the full knowledge and consent of the institute, as my statement that I read this morning indicates.

Senator SMATHERS. At that time, had you, by September 29, the time that you were at this meeting and Mr. O'Connor had previously asked you about this matter—had you done some tests on AD–X2?

Dr. WEBER. Previous to September 29?

Senator SMATHERS. September 29.

Dr. WEBER. Yes. Mr. O'Connor had—someone had sent me, and I believe it was Mr. O'Connor, but it may not have been—but someone had sent me a copy of the Bureau of Standards report. And I certainly was not going to go down and discuss the report with the people at the Bureau of Standards without having done any laboratory work.

Senator SMATHERS. That is right. Now, do you recall when you got that Bureau of Standards report, about when it was?

Dr. WEBER. July 1952.

Senator SMATHERS. In July?

Dr. WEBER. Yes.

Senator SMATHERS. I notice that in a news release dated April 17, 1953, and I am quoting here, you were asked to assist for the first time in August 1952, and the committee further requested that the Massachusetts Institute of Technology provide laboratory facilities. This continued:

> At no point in Professor Webers' report is there any criticism of any previous tests on this product, for none was reviewed.

I assume that President Killian, of course, was inadvertently in error.

Dr. WEBER. No. I think he was referring to any tests other than our own.

Senator SMATHERS. Did you say that somebody had sent you in July a copy of the report?

Dr. WEBER. Yes.

Senator SMATHERS. So then you had had an opportunity to review the findings?

Dr. WEBER. I had had an opportunity to review it; that is correct.

Senator SMATHERS. So when he said, however, quoting you, "for none was reviewed," that was just in error, I assume, and inadvertently?

Dr. WEBER. I think his statement said, "review and criticism," did it not?

Senator SMATHERS. I quote here:

> At no point in Professor Weber's report is there any criticism of any previous test on this product, for none was reviewed.

Dr. WEBER. I do not think any criticism of the product was reviewed.

Senator SPARKMAN. I suggest that that might mean that none was reviewed in his statement.

Dr. WEBER. None was reviewed in connection with my statement, in the report.

Senator SMATHERS. Let me just ask you one or two questions, and then I will quit. Mr. Goodwin—was that his name?

Dr. WEBER. Goodwin; yes.

Senator SMATHERS. He was a distributor up in the town where you lived?

Dr. WEBER. Oh, no. He is a distributor quite a ways removed from where I live.

Senator SMATHERS. Did he come to see you? How did you first meet him?

Dr. WEBER. I first met him—I went to see him in order to buy some of this material to see what it was and find out something about it, and he sent me some literature.

Senator SMATHERS. If he is such a long ways away from where you live, why did you go to see him?

Dr. WEBER. It so happens that his place of business was at one end of a line. I live at the other end of the line, and MIT is right in the middle, between. So I had a distance of about 5 or 6 miles to go to get to his place of business, and from where I lived, I would have had a distance of about 15 or 18 miles to go.

Senator SMATHERS. So you decided to go. Was there any other distributor any nearer you than that?

Dr. WEBER. No; not that I knew of.

Senator SMATHERS. I thought you said a moment ago that you first heard about this by reading about it and you wrote a letter.

Dr. WEBER. That is correct. But I wrote that letter to California. That was several years before.

Senator SMATHERS. That is right.

Dr. WEBER. So there was no distributor near me that I knew of.

Senator SMATHERS. How did you find out this distributor was there?

Dr. WEBER. Mr. Goodwin.

Senator SMATHERS. Yes.

Dr. WEBER. He suddenly sent me some literature, and to this day I don't know how he knew that I was interested in batteries. I asked him once and he just smiled and said nothing. I don't know how he found out that I was interested in batteries.

Senator SMATHERS. Have you seen Mr. Goodwin since that time?

Dr. WEBER. Oh, yes; many, many, many times.

Senator SMATHERS. Are you pretty good friends with Mr. Goodwin?

Dr. WEBER. I would say we are good acquaintances. I don't have many people that I call friends, but he is an acquaintance, certainly.

Senator SMATHERS. Is he as good a friend as some of your other acquaintances?

Dr. WEBER. He is not as close; no.

Senator SMATHERS. Let me ask you this: Did Mr. Goodwin have an opportunity to see the reports which you entered on your tests before they were made official?

Dr. WEBER. Oh, yes. Mr. Goodwin was present at several of the tests.

Senator SMATHERS. And do you know how the Small Business Committee actually got in possession of your final report?

Dr. WEBER. Yes. That was stated in the letter of transmittal, I believe, that accompanied my report.

Senator SMATHERS. Do you know that that was delivered by hand?

Dr. WEBER. Yes. The letter says, and I quote—this is a letter from Dr. Stratton to Senator Sparkman:

DEAR SENATOR SPARKMAN: This airmail letter is to advise you that we have this day transmitted two copies of the report prepared by Prof. Harold C. Weber concerning the effect of battery additive AD–X2 on lead acid batteries. Following your suggestion, we have entrusted these reports to Mr. Goodwin who will deliver them personally to you in Washington.

Senator SMATHERS. So Mr. Goodwin brought it down by hand?

Dr. WEBER. Yes. Evidently Dr. Stratton followed the suggestion which was in a letter from Senator Sparkman or over Senator Sparkman's signature saying that we send the report that way.

Senator SMATHERS. Are you aware that the findings which you made and the report which was submitted by MIT have been construed to support all the manufacturer's claims—that is, for AD–X2—the claims as to what it will do?

Dr. WEBER. Oh, yes. You mean in the newspapers?

Senator SMATHERS. In the newspapers; that is right.

Dr. WEBER. Yes; I am quite familiar with such.

Senator SMATHERS. And it undoubtedly has possibly resulted in the request for the resignation of the Director of the National Bureau of Standards?

Dr. WEBER. I cannot answer that question.

Senator SMATHERS. Are you familiar with the claims which the manufacturer makes in his article in Cars as to just what AD–X2 will do?

Dr. WEBER. I have a copy of that Cars, but I don't remember what he claims.

Senator SMATHERS. Let me just read it to you. It says:

I make, and can prove through scientific tests and sworn affidavits, these claims:

1. Battery AD–X2, when used to treat a new battery, will extend its normal life expectancy from 2 to 3 times. For example, if, through actual experience you know that the battery in your car will have to be discarded in about 16 months, your next new battery could be made to last from 16 to 32 months longer if you treat it when new with AD–X2.

2. Even if your battery is up to 12 months old, in a hard-rubber case and has not been abnormally abused, an AD–X2 treatment will give it added life.

3. If you've got a "dead" but mechanically sound battery—in other words, one which cannot be made to take a charge normally but is otherwise undamaged physically—you can restore it to a long and useful life with a proper AD–X2 treatment.

Now, do you think that the MIT report in any way substantiated the claims of the manufacturer?

Dr. WEBER. I did not interpret it.

Senator SMATHERS. You do not interpret it as substantiating the claims of the manufacturer?

Dr. WEBER. The MIT report?

Senator SMATHERS. In talking of the tests which were run by you, did you ever take some batteries similar to the ones which were treated

with AD–X2 and treat them with just a simple solution of sodium sulfate and magnesium sulfate?

Dr. WEBER. No; I did no work on sodium and magnesium sulfate at all.

Senator SMATHERS. Are you, as a chemist and scientist and all that sort of thing—I am sure you are—able to determine what ingredients are in AD–X2?

Dr. WEBER. Certainly a good analytical chemist could determine what was present in AD–X2.

Senator SMATHERS. Did you break down the AD–X2 to see what it had in it?

Dr. WEBER. No.

Senator SMATHERS. Are you willing to accept the statement of the National Bureau of Standards as to what its ingredients are?

Dr. WEBER. I have never seen the statement yet. I have heard of it, but I have never seen it.

Senator SMATHERS. If they said that it was principally a combination of sodium sulfate and magnesium sulfate and there were some 7 trace elements, less than one five-hundredths of 1 percent, or something like that, if that was what they wrote, would you be willing to accept that as being true?

Dr. WEBER. I think the Bureau of Standards is eminently competent to make such an analysis.

Senator SMATHERS. So if they said that that is what was in it, then you would be satisfied that that would be true?

Dr. WEBER. That is right. I would have no reason to doubt their analytical results.

Senator SMATHERS. Do you have any reason to believe that an ordinary mixture of sodium sulfate and magnesium sulfate in the same quantities which are mixed in AD–X2 could not do the same thing that AD–X2 does?

Dr. WEBER. I don't have any information; so I could not know.

Senator SMATHERS. Do you know anybody who has tried that?

Dr. WEBER. There have been various reports of people who have tried that material. It is my understanding that that simple mixture—this is hearsay—never mind it—it does give some effect, but I have no records of it.

Senator SMATHERS. That is what I hear. But I hear the other way, too. But I have heard that from——

Dr. WEBER. I have no scientific information on that.

Senator SMATHERS. I have heard that from quite a famous druggist who lives out in Chevy Chase that I go to and buy a few things from every now and then.

The retail price on a standard automobile battery with an 18-month guaranty is about $19; that with a 12-month guaranty is about $15. Do you think, as an expert in this business, that the manufacturers of storage batteries would be justified in inserting a package of AD–X2 into their 12-month guaranty and selling it for about $25, because then they could sell it as a 24-month guaranteed battery?

Do you not think that if AD–X2 did what it was supposed to do the manufacturers would be smart?

Dr. WEBER. I think you are a little out of my field, now, aren't you, Senator? I am a scientist.

Senator SMATHERS. What I am trying to get at is this. As I gathered from all that you are saying, even though you put AD–X2 in a brandnew battery which you had, you are not yet convinced or you have seen nothing that would lead you to believe that it actually has much effect one way or the other?

Dr. WEBER. I put water in the battery once in 11 months. That was very interesting to me.

Senator SMATHERS. Are you going to rely on that test or the test you made at MIT?

Dr. WEBER. No. I am not going to rely on that. That is not a scientific test.

Senator SMATHERS. What I am trying to get at is this. We have had some people come up here, as the chairman has mentioned, who made some very fine witnesses, particularly that fellow Blum last night, and we are trying to find out just how they can rely on the testimony as laymen. From your scientific experience, however, you do not quite come to that same conclusion as these laymen do.

Dr. WEBER. That is correct. And it is so stated in my report.

Senator SMATHERS. I think that is all I have to ask, Mr. Chairman, at this time.

The CHAIRMAN. Are there any other questions?

Senator SPARKMAN. I would like to ask 1 or 2 more.

The CHAIRMAN. Senator Sparkman.

Senator SPARKMAN. Doctor, was this test made without compensation, free of charge?

Dr. WEBER. Not only was the test made, but all expenses in connection with this work have been borne by me and by MIT with no compensation.

Senator SPARKMAN. Do you do very much of that?

Dr. WEBER. No. I did this as a public service. I felt I could not refuse when I was asked to do this by a Senate committee.

Senator SMATHERS. Mr. Ritchie had nothing to do with having you perform the tests?

Dr. WEBER. As far as I know he had nothing to do with it.

Senator SPARKMAN. I mean, as far as you are concerned?

Dr. WEBER. As far as I am concerned, he had nothing to do with it.

Senator SPARKMAN. The tests grew out of the conference between you and representatives of this committee and representatives of the Bureau of Standards?

Dr. WEBER. The MIT tests, I say, grew directly out of the September 29 meeting at the Bureau of Standards.

Senator SPARKMAN. That is what Senator Gillette asked you about a while ago?

Dr. WEBER. That is correct; directly out of that.

Senator SPARKMAN. Here is a question that comes over from yesterday. If you were here, you may recall that Dr. Astin stated in answer to a question which I put to him—and I am refreshed by one of Senator Smathers' questions—that in the chemical analysis of this AD–X2, it was broken down to a fineness of 5 points in a million; in other words, that the 7 trace elements were found to that extent. Is that a close enough analysis? Could there be other elements in there in that small amount, 5 points in 1 million, to be effective?

Dr. WEBER. I cannot answer your question. I do not know.

Senator SPARKMAN. Someone has told me—I have not read Dr. Vinal's book, but someone has told me—I believe it is in Dr. Vinal's book—that he points out that 3 parts in 1 million of iron could be quite effective on a battery within a couple of days.

Dr. WEBER. I distinctly remember in his book where he states that 10 parts in 1 million of manganese——

Senator SPARKMAN. Ten parts in one million.

Dr. WEBER. Ten parts in a million of maganese, I think his words are, will either ruin a battery or deterioriate it, or something to that effect.

Senator SPARKMAN. Now, I was impressed with your report. In the very beginning you state that there are no recommendations to be made because you are simply trying to find and set forth facts.

Dr. WEBER. That is correct.

Senator SPARKMAN. And these some eight points that are set forth right in the beginning of your report, those are the factual findings as you saw them; is that correct?

Dr. WEBER. Those are the facts.

Senator SPARKMAN. Now, have you read the interpretation of this report that was done by Dr. Laidler?

Dr. WEBER. Yes.

Senator SPARKMAN. Do you——

Dr. WEBER. Excuse me. I would like to correct that. I have read the Senate committee's press release. Is that what you are referring to?

Senator SPARKMAN. With the appendix.

Dr. WEBER. Yes.

Senator SPARKMAN. Dr. Laidler's statement was made an appendix to that.

Dr. WEBER. Yes, I have read that part.

Senator SPARKMAN. All right. Was that, in your opinion, or was it not a fair interpretation?

Dr. WEBER. It was not my opinion. He expressed an opinion of his own.

Senator SPARKMAN. Yes.

Dr. WEBER. He knows whether he is right in his opinion.

Senator SPARKMAN. Did he take your tests as if they had been sufficient—and you say that these tests you performed set out certain facts, but you are not willing to say that they are sufficient?

Dr. WEBER. I don't know whether Dr. Laidler based his opinion on just the MIT tests or whether he based it on the MIT tests and a great many other tests which I understood he had been studying. I have read the report.

Senator SPARKMAN. Now, one more question, and I will be through, Mr. Chairman.

In this statement of Dr. Beattie, his concluding paragraph was this:

> I would say that the addition of AD–X2 certainly does have an effect on the behavior of a lead-acid battery. From my brief contact with the work, I cannot say that this effect is correlated with a beneficial action from the standpoint of the normal use of such a battery. I feel that the latter can be determined only after the examination and statistical evaluation of extensive field tests.

Dr. WEBER. That is correct.

Senator SPARKMAN. Do I understand that that summarization on the part of Dr. Beattie represents pretty much your own thinking?

Dr. WEBER. I think it is a paraphrase of my own thinking.

Senator SPARKMAN. I thought that was in line with what you had testified to.

Dr. WEBER. Yes. It is a paraphrase of my own thinking.

Senator SPARKMAN. That is all, Mr. Chairman.

The CHAIRMAN. Thank you.

Senator SMATHERS. Mr. Chairman, let me ask just two more questions, please.

I am curious as to why, if the Massachusetts Institute of Technology was asked to run a test on this AD–X2, they would not analyze the ingredients of AD–X2.

Dr. WEBER. We naturally would have a scientific curiosity as to what the ingredients were. But it was immaterial as far as we were concerned, what the material was. It made no difference as far as our test was concerned.

Senator SMATHERS. You were looking for results, but would you not be able, at the fine institution that it is, to tell possibly why the results were being achieved, or no results, by virtue of what ingredients were in it?

Dr. WEBER. I wish we could, on matters of this type.

Senator SMATHERS. Do you think that is up to the usual standard of MIT tests, to be given a job like this and not even analyze what is in the formula?

Dr. WEBER. Surely. What difference would it make as far as the results were concerned that we were going to get?

Senator SMATHERS. I think that it would make possibly a good deal of difference. You are dealing with certain chemicals in a battery. And whether or not you had certain percentages of certain other chemicals would make it do one thing or another thing.

Dr. WEBER. I see, Senator. You think that possibly we, as trained scientists, would be able to predict from these trace elements, if they are there, and the percentages of them, as to how the material is going to perform?

Senator SMATHERS. I am not saying that, but I am saying this, that when I go to a doctor—and again I am getting into a field that I do not know—I like for him to look me over and see what is wrong with me. I don't like for him necessarily to take my word for it and say, "Now, if you can run around the block two times, you are in good shape."

That is about what you did. You said, "Well, if it works, it is good. And if it does not work, it is not good."

Dr. WEBER. That is correct; that is correct.

Senator SMATHERS. That is absolutely correct.

Senator SPARKMAN. You do not insist on his interpreting his prescriptions or the symbols?

Senator SMATHERS. It would seem to me that MIT, however, being the kind of institution it is, which is one of the best, would certainly make some sort of analysis of the ingredients. Now, they did not do it. So all right.

Dr. WEBER. Senator, I cannot imagine of what possible interest it would have been to us except out of curiosity.

Senator SMATHERS. You had enough curiosity even before you were asked to do it officially to try it out in your battery, and I just thought that maybe, being a good scientist, you would not want to put any-

thing in your battery that might damage it. Anyway, we can pass that over.

The CHAIRMAN. Senator Smathers, you have tried to raise a point, and it might be a question left in the record as if it had not been answered. Now, if you go to a doctor and you say that there is something wrong with you, and a doctor gives you medicine and you feel perfectly all right the next day, do you run back and say, "Now, Doctor, I want a chemical analysis of that"? You do not do that, do you?

Senator SMATHERS. Not if I run around the block.

The CHAIRMAN. No. But the idea is similar to your line of questioning.

Senator SMATHERS. But if I go to a doctor, he says, "I want you to leave certain mementos with me," and things of that sort.

The CHAIRMAN. No. The chemist was trying to find a result upon a battery, and you went to a doctor to get something to cure whatever you thought ailed you, and the doctor helped you. Did you run back the next day to get a chemical analysis of what has helped you? Now, that is the only question here.

Senator SMATHERS. I am not a scientist. I am just an ordinary citizen. Here is one of the greatest technical laboratories in the world, and they do not even take the trouble to analyze it. I think it was because they figured they knew exactly what was in it, and possibly that was it. Or they accepted somebody else's report on it.

Dr. WEBER. As a matter of fact, I had been accepting the Bureau of Standards' analysis as to what was in it up to that time.

The CHAIRMAN. Doctor, I wish you would clear this record so that there cannot be any doubt, as to whether it was important to you that you make an analysis of it or to try to determine the effects of the product in your battery.

Dr. WEBER. The only thing that I was interested in, to help the committee, was to determine the effects. I did not care what it contained. I had a curiosity as to what it contained.

Senator SMATHERS. Did you not determine how much acid density it had in it?

Dr. WEBER. Acid density?

Senator SMATHERS. The acid density of the battery.

Dr. WEBER. The acid density of the battery?

Senator SMATHERS. Yes.

Dr. WEBER. Yes.

Senator SMATHERS. All right. Now, wasn't that of some chemical importance to you?

Dr. WEBER. That was of some importance to me.

Senator SMATHERS. That is right.

Dr. WEBER. Some.

Senator SMATHERS. And when you take a solution of magnesium sulfate and sodium sulfate and mix it, does that not change the specific gravity?

Dr. WEBER. Surely. It is reported—I don't know for magnesium sulfate. But the change in gravity for AD–X2——

Senator SMATHERS. I do not know anything about it, but I can tell you from high authorities that it changes the specific gravity. Is that right?

Dr. WEBER. It does, yes.

Senator SMATHERS. So that sort of becomes important to you?

Dr. WEBER. Yes. And I did get the change in gravity that was brought about when I added AD–X2, because that was of interest to me.

Senator SMATHERS. That is right. And you could have put some other things in there which would not possibly have changed the specific gravity as much?

Dr. WEBER. Yes, I could have; that is correct.

Senator SMATHERS. Now, while we are talking about acid density, do you recall what the acid density was of the batteries which you tested?

Dr. WEBER. I don't understand your phraseology "acid density." You mean the specific gravity?

Senator SMATHERS. No. What I am trying to say is this. I am asking about this. What was the acid density? How high was it?

Dr. WEBER. It is all recorded in the report, Senator, for every single battery, and I have given it in my statement this morning.

Senator SMATHERS. Can you take the trouble to let me have it?

Dr. WEBER. Yes, sir. Have you a copy of the report?

Senator SMATHERS. Yes.

Dr. WEBER. It is all reported in the back of the report, in the appendix.

Senator SMATHERS. I know that. But how about this——

Dr. WEBER. There was one battery, you remember, that I put water in only.

Senator SMATHERS. That is right.

Dr. WEBER. I think there were 26 in which I put 1.100 specific gravity acid, and in the others, you remember, they had some of the original electrolyte left in them. So I did what you would normally do. I filled them up to the proper level with water. And some of those gravities were less than 1.100.

Senator SMATHERS. Less than 1.100?

Dr. WEBER. Yes.

Senator SMATHERS. And you did not think that that made much difference in the results?

Dr. WEBER. It could have made a difference.

Senator SMATHERS. Did you think that it made a difference?

Dr. WEBER. I do not know. I could not tell whether it made a difference or not until I got the results.

Senator SMATHERS. When you got the results, did it make any difference?

Dr. WEBER. Whether they were 1.100 or less?

Senator SMATHERS. Yes.

Dr. WEBER. Some, perhaps. I have seen the discharged batteries——

Senator SMATHERS. Now, you are a scientist. I can understand a layman or a politician talking about "some," and "I think so," and all that. But a scientist is supposed to be exact. Did it or did it not?

Dr. WEBER. Have an effect?

Senator SMATHERS. The 1.100.

Dr. WEBER. Oh, yes. I have often seen discharged batteries that had gravities of far less than 1.100, and measured them.

Senator SMATHERS. You do not remember, whether a gravity of less than 1.100 had any adverse effect on the tests, do you?

Dr. WEBER. No. I don't know whether it had an adverse effect or a beneficial effect, to tell the truth.

Senator SMATHERS. Remember, you are a scientist.

Dr. WEBER. That is right.

Senator SMATHERS. Now, is it your opinion that it probably did not affect it one way or the other?

Dr. WEBER. I don't know. It is conceivable that it might have affected it one way or it might have affected it another.

Senator SMATHERS. Then, would you be able to say possibly in using AD–X2 on some batteries, if the specific gravity was less than 1.100, it might or might not have an effect? That is your statement?

Dr. WEBER. That the specific gravity might or might not; not the AD–X2.

Senator SMATHERS. I do not mean the specific gravity. I mean the acid density.

Dr. WEBER. That is what I mean by specific gravity.

Senator SMATHERS. Well, let us stick to one or the other. I am confused already.

Dr. WEBER. If you will stick to specific gravity, I will not be confused.

Senator SMATHERS. Let us talk about acid density——

Dr. WEBER. All right.

Senator SMATHERS. You had an acid density of the solution of less than 1.100?

Dr. WEBER. That is correct.

Senator SMATHERS. And you say——

Dr. WEBER. That was only in probably less than half of the tests.

Senator SMATHERS. That is right.

Dr. WEBER. Half of the tests had a gravity of roughly 1.100.

Senator SMATHERS. So far as you say, it did not make too much difference?

Dr. WEBER. I do not know.

Senator SMATHERS. Now, the one complaint that Mr. Ritchie had about the tests of the National Bureau of Standards was that the acid density was 1.160, which was higher than you ran your tests on.

Dr. WEBER. No. I thing you have the numbers wrong, Senator.

Senator SMATHERS. Well——

Dr. WEBER. Let me help you.

Senator SMATHERS. I would appreciate it.

Dr. WEBER. Mr. Ritchie was talking about a specific gravity up in the range of where the battery was fairly well charged, and he was worried that up at those high gravities it would have an adverse effect on the AD–X2 treatment, or the AD–X2 effect. Now, you and I now are discussing gravity very, very much lower than that, and the effect could be quite, quite different.

Senator SMATHERS. Does not the specific gravity change whenever you put almost anything that is soluble in this acid in the batteries?

Dr. WEBER. Yes; and I have so recorded the change that does occur in my report when AD–X2 is added. It is recorded in three or four places.

Senator SMATHERS. As long as we got into this, did you not write in this report that this possibly meant that the batteries would run cooler with this AD–X2?

Dr. WEBER. No. What I said was that on the tests I made, I had found that after statistical analysis—I did not do the statistical analysis—that after statistical analysis had been made, the results showed that the treated batteries ran 2° to 5° cooler than the untreated.

Senator SMATHERS. Do you think that makes a great deal of difference in the battery in your automobile?

Dr. WEBER. Oh, I don't know. If I had known some of the answers to your questions, I probably would have been a little more positive.

Senator SMATHERS. The reason why I asked this question was because, as I was looking through this report—I do not seem to find it now—I had come across where you said that it makes the battery a little cooler. And yet as I looked at the figures, it seemed that your figures indicated that it made it 10° hotter.

Dr. WEBER. Oh, no.

Senator SMATHERS. So I thought I might ask you to educate me on that.

Dr. WEBER. I am sure you are confused, Senator, on that.

Senator SMATHERS. That is not beyond the realm of possibility.

Dr. WEBER. I am afraid you confused specific gravity with temperature in your memory.

Senator SMATHERS. I will find it in just a minute.

Dr. WEBER. Perhaps I can help you find the place.

Senator SMATHERS. I think if you look on page 29, "charged cells 4 and 5," for example, cell No. 4——

Dr. WEBER. Yes.

Senator SMATHERS. Now, do you find that that goes up or comes down?

Dr. WEBER. When you charge it?

Senator SMATHERS. No; the temperature.

Dr. WEBER. Now, what do you want me to do, Senator? Tell me just what you want.

Senator SMATHERS. All I want you to do is tell me whether or not these figures indicate that AD–X2 makes it cooler or hotter, the cells.

Dr. WEBER. Oh, you are just picking out one experiment, as I understand it.

Senator SMATHERS. Well, did not those two indicate that they are hotter?

Dr. WEBER. I cannot understand—you mean, as the charge goes on, that they get hotter?

Senator SMATHERS. Let us look here on page 26 of the appendix.

Dr. WEBER. Yes.

Senator SMATHERS. Cell No. 1.

Dr. WEBER. Yes.

Senator SMATHERS. Cell No. 2, and cell No. 3.

Dr. WEBER. Yes.

Senator SMATHERS. Under the heading of "Temperature," under each one——

Dr. WEBER. Yes.

Senator SMATHERS. The temperature runs—you have the time here on it, the time when you made these tests?

Dr. WEBER. Yes.

Senator SMATHERS. It runs from 26.5 to 29.0. Then down below them on September 18, 1952, you run from 23 up to 34. Do you see it there?

Dr. WEBER. I do not see the 23 to 34. Where is that?

Senator SMATHERS. Do you see the 23?

Dr. WEBER. I haven't found that yet.

Senator SMATHERS. Do you see the temperature column?

Dr. WEBER. I see where you mean now. You are talking about page 26, after September 18?

Senator SMATHERS. Right.

Dr. WEBER. Yes; I see where it goes from 23 to 34.

Senator SMATHERS. Is that cooler or hotter?

Dr. WEBER. That is hotter.

Senator SMATHERS. Do you see the next line on cell 2, where it runs from 26 to 37?

Dr. WEBER. Yes.

Senator SMATHERS. Is that cooler or hotter?

Dr. WEBER. Senator, what you are saying is this. You are saying as the battery charges, does it heat up or does it cool off. And as the battery charges, it heats up. But what you must do, Senator, is to compare a treated cell at a certain period of time after the charge starts with an untreated cell, and then see which one is hotter at that time. Probably all batteries heat up as you charge them. You must not interpret the data that way, Senator.

Senator SMATHERS. Did you compare a battery in your test, an untreated battery, with a treated battery?

Dr. WEBER. Oh, yes. Roughly, half of my batteries were untreated. And, you see, all of these temperature measurements that we are discussing were then taken by the statisticians and a statistically correct result was obtained from them, and that is given in the report. You are making the wrong kind of comparison, Senator.

Senator SMATHERS. Well, all right. That may be.

Senator SPARKMAN. May I ask, is it shown in here anywhere which cells were treated and which were untreated?

Dr. WEBER. Yes. The cells with an asterisk are the treated ones.

Senator SPARKMAN. Oh.

Dr. WEBER. You see, he is talking about a test—I think he is talking about a test—before any AD–X2 was ever added to those cells. I think that is the preliminary test, although I am not sure of that.

Senator SMATHERS. You have AD–X2 added here on cell No. 2.

Dr. WEBER. That is right, on cell No. 2.

Senator SMATHERS. And it still gets hotter.

Dr. WEBER. In that particular case, cell No. 2 ran hotter, Senator. I am not sure, but cell No. 2 was a defective cell, as I recall it.

Senator SMATHERS. Then turn over to page 29. You have some explanation for all these wide ranges. Explain to me why it says, "Temperature cannot be read—cannot get thermometer into cell."

Dr. WEBER. This is on cells 4 and 5. You see, we had discussed at the Bureau of Standards that the——

Senator SMATHERS. In other words, you could not get the thermometer in cells 4 and 5, but you could get it in these other cells?

Dr. WEBER. Yes. Now, let me explain, Senator. The difficulty of making temperature measurements with a thermometer is this. This was discussed at great length at the Bureau's meeting. In order to get

a satisfactory temperature measurement the bulb of the thermometer at least must be immersed in the material whose temperature you are measuring.

Senator SMATHERS. That is right.

Dr. WEBER. Now, in many batteries there is not room enough above the plates or above the separators to get the whole bulb of the thermometer immersed. Now, to get around that, what I did in a great many of my batteries—and it is mentioned in the report—I took the whole top off the battery so that I could get the thermometer in, so that I would be sure to get a representative temperature measurement.

You see, if you put the thermometer in the battery, and you cannot get the bulb immersed, then your next reaction is to force the bulb down, and the separator breaks, and your results may be unsatisfactory. So when I got temperature measurements, I either had removed the top from the battery or I had assembled the case with no top.

Senator SMATHERS. Doctor, one more question and I will quit. You have never had any association whatsoever with the AD–X2 manufacturing corporation?

Dr. WEBER. Absolutely none.

Senator SMATHERS. Pioneers, Inc.?

Dr. WEBER. Absolutely none. By "association," you mean financial?

Senator SMATHERS. That is right. I do not mean friendship.

Dr. WEBER. Yes.

Senator SMATHERS. Have you ever had any association with Mr. Goodwin?

Dr. WEBER. None, except what I mentioned here.

Senator SMATHERS. You never had any business interest with him whatsoever?

Dr. WEBER. No. And you notice that it is definitely stated—I think it is stated in the report, is it not; in Dr. Stratton's letter?

Senator SMATHERS. You have no personal or financial interest in this AD–X2 in any way whatsoever?

Dr. WEBER. In answering that question, may I quote from Dr. Stratton's letter of transmittal that went with the report?

Senator SMATHERS. Surely.

Dr. WEBER (reading):

> The MIT staff members who worked on the tests received no compensation from any source, and they have no financial or consulting interest in the product tested or in any other similar products.

I think that answers your question, Senator.

Senator SMATHERS. Do you know Mr. Ritchie personally?

Dr. WEBER. Oh, I have met Mr. Ritchie 3 or 4 times, I think. I would say that I know him to that extent personally.

Senator SMATHERS. However, other than these tests, you do not know him? He is not one of your acquaintances?

Dr. WEBER. No.

Senator SMATHERS. So this has been done completely scientifically, as far as you are concerned, and the only conclusion that you make is that reported here where you say that Dr. Beattie paraphrased you when he said that he inferred that they were not just sure what beneficial results there are from AD–X2?

Dr. WEBER. I would like to quote again from the letter of transmittal that went with the report:

I would point out further that there are no recommendations included in the report, nor did our group arrive at any definitive conclusions with respect to the commercial value of the products. The report sets forth the results of very careful laboratory tests, and these results have been corroborated and analyzed statistically.

The CHAIRMAN. In other words, Doctor, the conclusions as reported by you are accurately based on MIT's statistical analysis that was recorded as the tests proceeded?

Dr. WEBER. After the test was finished. The statistical analysis was made after the test was finished.

The CHAIRMAN. But it was official? There was no question about the accuracy of them?

Dr. WEBER. None that was raised by the statisticians. Everything the statisticians had to say about the test is included in the report.

The CHAIRMAN. Dr. Weber, we want to thank you and MIT for the public service that you have rendered in making this test without compensation. This, we thank you for.

We realize that we are apt to be called over on the floor any moment. But I would like at this time to swear in the next two witnesses, and I want to swear both of them in jointly, and then we will reconvene at 2 o'clock this afternoon. But if Mr. Walker and Mr. Beene will step forward, we will swear you in, and then you will know that you are going to be the two gentlemen who will be heard when we reconvene at 2 o'clock.

Mr. Walker and Mr. Beene, come to the table here. The reason that I am swearing both of you gentlemen in at one time is that you have expressed a desire that you might both sit together at the table.

Mr. Walker and Mr. Beene, do you swear that the testimony you are about to give pertaining to the matter now before this committee is the truth, the whole truth, and nothing but the truth, so help you God?

Mr. BEENE. I do.

Mr. WALKER. I do.

The CHAIRMAN. We will stand in recess until 2 o'clock. When we resume, these two gentlemen will be the next witnesses.

(Whereupon, at 12 noon, the committee recessed to reconvene at 2 p. m. of the same day.)

AFTERNOON SESSION

The CHAIRMAN. It is now 5 minutes after 2, and, if we may please come to order, we will resume the hearing.

We have with us Mr. J. W. Walker and Mr. Beene.

We will call Mr. Walker first.

You may proceed to inform the committee in whatever manner you desire; but, for the record, I would like to have you state your name in full, by whom you are employed, and what your classification is as such an employee. Then you may proceed.

If Mr. Beene makes a statement, we will then have Mr. Beene state for the record at that time his name and the other pertinent information so the record will be complete as to his identity before he makes his statement.

You may proceed, Mr. Walker, in any manner that is comfortable to you.

TESTIMONY OF JACK W. WALKER, MATERIALS ENGINEER, McCLELLAN AIR FORCE BASE, SACRAMENTO AIR MATERIEL AREA, SACRAMENTO, CALIF.

Mr. WALKER. My name is Jack W. Walker. I work at the McClellan Air Force Base at Sacramento, Calif. My civil-service designation is materials engineer.

The CHAIRMAN. Materials engineer?

Mr. WALKER. Yes.

I would like to proceed with a few notes that I have regarding the tests I conducted at Sacramento in 1948.

In May of 1948 I received a project directive from Headquarters, Air Materiel Command, to test Battery AD–X2, formerly known as Protecto-Charge, in batteries at McClellan Air Force Base.

Any reference I make henceforth to reports or letters are part of the file that will be made available to this committee.

I would like to read that project directive. It is from Wright-Patterson Air Force Base to the Commanding General at McClellan Air Force Base:

Project P–893–SC is assigned your depot for the service testing of automotive type batteries treated with Protecto-Charge. This project is to service test Protecto-Charge which is manufactured by Pioneer, Inc., 2411 Grove Street, Oakland 12, Calif., and distributed by Embree & Co., 110 Market Street, San Francisco 11, Calif. In order to accomplish the project you are advised to select from salvage, disposal, or reparable stock at your depot 5 each 6-volt and 5 each 12-volt batteries (mechanically sound old batteries) on which recharging has failed to return batteries to a serviceable condition. These batteries should be free of decomposed or buckled plates, split separators, broken cases or terminals or any other deficiency which may attribute to a short circuit in a cell. Removal of battery mud on bottom of case or sulfate from the plates is not required, as it is the purpose of Protecto-Charge to dissolve these materials and return the battery to a serviceable condition. Obtain 1 each 6-volt and 1 each 12-volt new battery from class 19C stock and add electrolyte. If new batteries are not available from local stock, they should be procured locally in order to expedite the test. Authorization is granted your depot to directly contact the distributing agency for Protecto-Charge for the necessary materials required and pertinent technical data covering application of this project. Mr. Charles F. Embree, representative of Embree & Co., during his recent visit to this headquarters, signified his willingness to furnish, at no cost to the Government, sufficient quantities of Protecto-Charge to accomplish a service test on the above-mentioned batteries. Instructions to be followed in the accomplishment of this project are as indicated in attached instruction sheet. Request status of this project be reported semimonthly in accordance with AMC Reg 15–66–14.

Attached are the instructions for testing Protecto-Charge automotive batteries:

1. Identification of batteries will be as follows and tagged accordingly:

	6-volt	12-volt		6-volt	12-volt
New Batteries	A–6	A–12	Old batteries	D–6	D–12
Old batteries	B–6	B–12	Do	E–6	E–12
Do	C–6	C–12	Do	F–6	F–12

2. Clean battery and terminals, cover plates of the battery with water and empty 1 envelope of Protecto-Charge into each cell. Dissolve the material on top of battery plates with battery syringe. Recharge at a rate of approximately 4 amperes and return battery to a specific gravity of not less than 1.225 or more than 1.280; and 1.280 specific gravity should not be exceeded.

3. Install the new batteries and 4 each of the 6- and 12-volt old batteries in vehicles subjected to heavy duty operation for which repeated startings of engines are necessary.

4. One each of the old 6-volt and old 12-volt batteries is to be stored and not installed in vehicles while service test is in progress.

5. Once every 15 days, each battery will be checked for general condition, the presence of deposits on top of battery, and the specific gravity of electrolyte in each cell. In addition to this check one each of the old installed 6-volt and 12-volt batteries will be subjected each 15-day period to extra heavy load until starting motor shows evidence of heating or battery failure is indicated.

(*a*) These should be conducted over a period of 120 days, whereupon the necessity for continuation of the test will be determined based on results obtained.

(*b*) It is not considered necessary for Headquarters personnel to assist in the installation and operation of this service test unless required by your depot.

(*c*) A service-test report containing detailed findings of each 15-day inspection will be prepared by battery identification and will be furnished this Headquarters. Comments and recommendations should be provided by your depot. Send 2 copies of each report to this Headquarters, attention: MCMMXT53.

(*d*) Batteries used for this service test—

The CHAIRMAN. Who signed that order to you, sir?

Mr. WALKER. This is signed by Colonel Endress.

The CHAIRMAN. His initials are what?

Mr. WALKER. Albert V.

The CHAIRMAN. Thank you.

Mr. WALKER (reading):

Batteries used for this service test will be continued in service provided failure has not occurred during the period of service test. In case of failure, disposition of batteries will be made in accordance with administrative practices.

The first thing I did was to select 10 salvage batteries and obtain 2 new batteries from stock. These batteries were selected and checked for buckled plates, split separators, and so forth. This was to assure that mechanically sound batteries were used.

The old batteries were then placed on the charging line and AD–X2 was added soon after the batteries were placed on charge.

Mr. Chairman, may I bring a point of clarification in at this time? The directive makes reference to Protecto-Charge. Other correspondence in our file refers to AD–X2, and the rest of the correspondence I have refers to AD–X2. Evidently the name must have been changed.

The 10 old batteries were left on the charging line until they were fully charged. At this point battery specific gravity, temperature, and voltage were recorded. This was to determine if the batteries had taken a charge.

The old batteries were then installed in various ground-handling equipment, and automotive vehicles, anywhere from 1 to 15 days after they had been given a charge.

The first report outlines these details. These details are outlined by means of a statement on each battery. This statement consists of what type battery it was, and in what condition the battery was, when checked and treated with AD–X2. It shows the total time it took to charge the battery, the state of charge of the battery, to what type equipment the battery was assigned.

I do not want to take the time of the committee to read these detailed reports. I will submit them for the record.

The CHAIRMAN. How many minutes will be required to read that detailed report?

Mr. WALKER. It is quite lengthy, sir, and there are seven complete test reports—it would require a long and involved process to read those reports.

The CHAIRMAN. Then we will pass over them and proceed with your statement, and they will be part of the record.

(The documents referred to were marked "Exhibit No. 14" and appear in the appendix.)

Mr. WALKER. The new batteries first had electrolyte added as per manufacturer's instructions; that is, the battery manufacturer's instructions, and were then treated with AD–X2.

My notes of 1948 on the first report do not show that one of the new batteries was treated. However, I do recall that all of the batteries were treated.

The CHAIRMAN. Who made the error?

Mr. WALKER. It is possibly a typographical error; just exactly where it was in the report I do not know, but there is no mention——

The CHAIRMAN. It is your honest opinion that all the batteries were treated?

Mr. WALKER. Yes; all of these 12 batteries I am talking about were treated.

The first report also contained a recommendation to Headquarters, Air Materiel Command, that a 40-ampere-hour life cycle test be given to the two new batteries. This is the standard test used by industry to determine battery performance.

Between the 15th and 30th day each battery treated was checked for condition, and periodically I submitted my reports with comments and recommendations to Headquarters, Air Materiel Command.

The second report contained a condition check of the batteries undergoing service tests. I would like to refer to comments in the second and subsequent reports showing typical battery results. In the second report, in paragraph (c), there is a note that I had considerable trouble with one of the jeeps charging system. Evidently the relay system was not set at a sufficiently high voltage to maintain a charge on the battery.

The CHAIRMAN. How many batteries did this involve?

Mr. WALKER. This was 6–C battery; one battery.

The CHAIRMAN. One battery?

Mr. WALKER. It is just a point here, Mr. Chairman, that I brought out that it was vehicle trouble in the charging system.

On my battery No. 6–D, it was noted it was losing by internal local action and the low rate of charge; that is, the battery was self-discharging. This was installed in a crane. This crane was working about 2 hours a week, and it was evident at that time that the charging system of the crane was not maintaining enough to keep the battery charged.

I also had another trouble with a battery when the holddown screws that fasten the battery into the jeep were too tight and caused the case to break. That particular case was repaired. That particular cell on the battery in the reports shows the specific gravity on this particular cell was low.

The CHAIRMAN. Was that the cell where the crack in the case of the battery case occurred?

Mr. WALKER. Yes, sir.

The CHAIRMAN. Did that permit a leakage?

Mr. WALKER. It permitted a leakage of the electrolyte; consequently, we repaired the case, only added distilled water, and continued on with the service test.

The 12-volt A battery was in very good condition; the 12-volt C battery was in fair condition. The one failure that I had was the 12-volt E; the battery completely failed.

In the third report on the 6–E battery, the local action on this one was such that the battery was abnormal.

The rest of the reports on the batteries are detailed reports of the condition of the battery in relationship to specific gravity, temperatures, times, charging cycles, discharging cycles, complete with very minute details of battery characteristics.

I would like to call your attention to the fourth report, starting on page 7:

Inasmuch as the next 15-day period will terminate assigned project P–893–SC, the following is recommended:

(*a*) The present 6 VA, 6 VB, 6 VC, 6 VD, 6 VF, 12 VA, 12 VB, 12 VC, 12 VD, and 12 VF batteries will remain under the conditions outlined in basic correspondence for a period of 1 year and once each 30-day period a report of general condition of these batteries be forwarded your command.

Those batteries were treated 4 months prior and were still functioning in the various vehicles. Also, I made the recommendation to select 3 each 6-volt batteries and 3 each 12-volt batteries, and subject them to a service test; also, it outlines a charging and discharging test.

All subsequent reports to this reported on the batteries and the battery conditions showed detailed matters as to how they were functioning and what they were doing. These are also included in reports made available to this committee.

In September of 1948 I received a letter from the Headquarters, Air Materiel Command, to the commanding general, McClellan Air Force Base, to turn over to Pioneers, Inc., 6 each aircraft batteries. The purpose of this letter was for Pioneers, Inc., to conduct service tests on the lead-acid battery of the aircraft type.

A few days later I received a carbon copy of a letter Pioneers, Inc., sent to Headquarters, AMC, where they requested that the aircraft battery service test be conducted at McClellan Air Force Base.

Headquarters, Air Materiel Command, gave McClellan Air Force Base the authority to conduct these service tests on aircraft batteries, in conjunction with and under the same project number with the ground battery tests, and sent copies of appropriate battery specifications for us to use as a guide in conducting our tests.

The rest of the reports are the detailed findings of the batteries, the condition when checking such as times, temperature, specific gravity, battery performance.

On February 15, 1949, I wrote a letter to Pioneers, Inc., regarding a foaming characteristic that I discovered in the aircraft batteries, and I would like to read that letter.

It is to Pioneers, Inc., 2411 Grove Street, Oakland 12, Calif., attention Mr. Ritchie.

1. Request technical informational data as to how to eliminate the foaming process which occurs with your additive during the charging cycle, as outlined in step 1, basic F–1 and G–1 service test instructions.

These letters are available to the committee.

As you will note by the attached photographs, aircraft batteries that are under Arctic conditions with an increased charging voltage will lose 60 to 70 percent of their electrolyte through the vent cap, with the result the electrolyte will be transposed to the vent chamber of the battery.

This feature is very undesirable and hazardous to the aircraft structure in the immediate area of the battery.

At present, all aircraft service tests have been suspended pending your detailed information to Headquarters, Air Materiel Command. This should be sent to the commanding general, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, attention: MCMMXT31/MLT.

On the same day I sent a letter to the commanding general of the Air Materiel Area, informing him of this foaming process.

The CHAIRMAN. Was this foaming developed after you added the AD–X2?

Mr. WALKER. Yes; this was a comparable test of treated and untreated batteries.

The CHAIRMAN. Would that same battery foam without the AD–X2?

Mr. WALKER. The particular test, Mr. Chairman, was this: I had two untreated batteries and two treated batteries in a cold chamber.

The CHAIRMAN. Yes.

Mr. WALKER. The charging and the discharging equipment was connected to the batteries through the cold chamber. It is a matter of cooling the cold chamber down, then taking the battery through the charging and discharging cycles. The untreated batteries did not foam; the treated batteries did foam.

The CHAIRMAN. Was that letter addressed to Ritchie for information about that?

Mr. WALKER. Yes, sir.

The CHAIRMAN. Did Mr. Ritchie give you a reply on it?

Mr. WALKER. Yes, sir; that was my next letter that I was going to read.

The CHAIRMAN. All right; I am sorry to interrupt.

Mr. WALKER. At the end of March—excuse me—just a minute, sir. On February 23 I received a message from Air Materiel Command, which stopped all service tests. I make reference to the teletype from AMC.

The CHAIRMAN. You have not yet reached that reply that Mr. Ritchie was supposed to give to you.

Mr. WALKER. In the next sequence of events, at the end of March 1949, I received a carbon copy of a letter which Pioneers, Inc., sent to the Air Materiel Command. I would like to read that letter. It is addressed to Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, on the subject Status and Information of Assigned Aircraft Battery Service Test of February 15, 1949:

There is no way of eliminating the foaming process mentioned in this paragraph when our additive is used. Our investigations show this foaming process is not uncommon in new batteries of the type under discussion, when operated below 0° F.

This so-called foaming is due to an increase in porosity of the plates in batteries treated with AD–X2, which allows gassing on increased charging voltage over the entire surface of the plate area in very fine bubbles instead of gassing in large bubbles between the grid and the active material when sulfation resistance is present. The same reasoning is applied to new batteries prior to the formation of sufficient insoluble sulfate crystals which create resistance to the charge on the surface of the plates.

We have given thought to the installation of a baffle in the electrolyte chamber for the breaking up of these fine bubbles. However, study has shown that this would create a critical electrolyte level. Therefore, we recommend that the battery be redesigned and that sufficient room be left between the electrolyte

chamber and the gassing chamber to allow for the dissipation (bursting) of these fine bubbles in healthy batteries (sulfation free), before the fine bubbles are forced into the gassing chamber resulting in the referred-to undesirable condition.

The CHAIRMAN. You say the treated batteries were the ones that foamed; the nontreated battery did not foam?

Mr. WALKER. The nontreated batteries did not foam.

The CHAIRMAN. If a battery foams you are apt to have liquid leakage; you have the liquid leakage about the battery case.

Mr. WALKER. That is correct, sir.

The CHAIRMAN. And that acid will eat anything it gets in contact with, so, therefore, it would be very serious if you have such foaming?

Mr. WALKER. It would be very serious.

The CHAIRMAN. And the treated batteries foamed and the others did not?

Mr. WALKER. The aircraft batteries foamed; yes.

The CHAIRMAN. Yes.

Mr. WALKER. My own conclusion is that batteries treated with AD–X2 will foam at low temperatures as referred to in the letters I have discussed.

My experience with untreated aircraft batteries is that foaming is not common, and never have I seen an untreated battery foam when it was installed and under operation. This foaming process will cause the electrolyte to come out of the battery vent cap, and will also cause the battery to stop operating because eventually there will be an excessive loss of electrolyte.

The CHAIRMAN. Do you know whether an ordinary battery, that is, a battery constructed for automotive use, would act similarly under cold temperatures?

Mr. WALKER. The gassing, as referred to in the letter—it will gas. I have not conducted cold-chamber tests on automotive-type batteries.

The CHAIRMAN. Just the airplane batteries?

Mr. WALKER. Just the aircraft-type batteries.

The CHAIRMAN. Of course, the airplane battery is different.

Mr. WALKER. The aircraft type is different only in construction.

The CHAIRMAN. It is differently constructed because it must conserve space.

Mr. WALKER. They must conserve space.

The CHAIRMAN. That is why you have the thinner plates.

Mr. WALKER. Thinner plates.

The CHAIRMAN. Less weight.

Mr. WALKER. Less weight; that is correct. The acid which comes outside the battery, because of foaming, will result in damage to the aircraft structure and/or equipment in the immediate area.

From all my experience in conducting the AD–X2 tests at McClellan Air Force Base in 1948, I am of the opinion that the tests were inconclusive except for that one foaming characteristic on aircraft batteries.

The CHAIRMAN. You said inconclusive?

Mr. WALKER. Inconclusive. My reason for stating that the tests were inconclusive is because too many variables, such as ignition keys being left on, damage to battery seals, generator failures may have affected my testing results. I further concluded that AD–X2 could

only be properly evaluated through controlled laboratory or shop tests over a prolonged period of time.

The CHAIRMAN. I did not quite understand your last statement.

Mr. WALKER. I further concluded from my test reports that AD–X2 could be properly evaluated through controlled laboratory or controlled shop tests over a long period of time. As an example, a normal battery should operate, if it has a guaranty of 12 months, approximately 12 months.

The CHAIRMAN. How long a period of time were you observing these batteries under this test?

Mr. WALKER. This period was approximately a 5-month period.

The CHAIRMAN. Five months?

Mr. WALKER. Five-month period; yes.

The CHAIRMAN. What was your own personal evaluation of the compound at the end of that test?

Mr. WALKER. My personal opinion on the compound, the batteries were functioning, 11 of the 12 batteries I started out with were still functioning, and one of my last recommendations was that the service test should continue so we could continually evaluate these batteries.

The CHAIRMAN. Did the used batteries perform as well as the new batteries that were put under the test?

Mr. WALKER. The used batteries were performing their functions in their respective vehicles.

The CHAIRMAN. You could not see any difference on them from what you did on the new batteries?

Mr. WALKER. They were starting the engines, sir; they were performing; they were maintaining their charges; they were functioning normally.

The CHAIRMAN. What was your opinion—if this had been money out of your own pocket, would you have bought the additive for the purpose of prolonging the life of the battery or aiding the so-called old batteries to perform more efficiently; would you have spent the money? We are just trying to get information. You say that your test was not long enough to arrive at a positive answer?

Mr. WALKER. A positive answer.

The CHAIRMAN. As best you could?

Mr. WALKER. As best I could.

The CHAIRMAN. Under the circumstances?

Mr. WALKER. Under the circumstances.

The CHAIRMAN. Therefore, just in order to get your honest opinion on the question, I wanted to know whether you would have bought the product, that is, AD–X2, and put it in a battery if it were out of your own pocket.

Mr. WALKER. To prolong the life of a battery I would at that time have liked to observe further results. The results that I was getting at that time were very good.

The CHAIRMAN. Were those used batteries some which would have performed without the additive?

Mr. WALKER. That I cannot say, sir.

The CHAIRMAN. How many years have you worked with batteries?

Mr. WALKER. I had had approximately 2½ years' experience before that.

The CHAIRMAN. Two and a half years before that?

Mr. WALKER. Before the tests.

The CHAIRMAN. What was the nature of your battery experience?

Mr. WALKER. Making sure the necessary shop equipment was available, such as charging equipment—this was really from a layout standpoint—also that the technical orders were taken care of, that our batteries were charged and recharged. I worked only in a staff capacity.

The CHAIRMAN. What is your specific duty, or what are your specific duties? Do you just supervise the men?

Mr. WALKER. No; I am from the Engineering Department.

The CHAIRMAN. Engineering Department?

Mr. WALKER. In a staff capacity.

The CHAIRMAN. Do you handle the batteries or supervise the details of men who handle the batteries?

Mr. WALKER. Only the technical phases.

The CHAIRMAN. Just the technical phases?

Mr. WALKER. Yes, sir.

The CHAIRMAN. You do not have any experience with the service end of the shop where these batteries were working?

Mr. WALKER. No, I do not. I don't physically work in the shop.

The CHAIRMAN. Your final opinion was that you did not think you had sufficient opportunity to run the test to have arrived at any conclusions?

Mr. WALKER. That is in my last 3 or 4 reports, and they were my major recommendations.

The CHAIRMAN. The test was discontinued, and no order placed for the powder?

Mr. WALKER. No, sir.

The CHAIRMAN. I beg your pardon?

Mr. WALKER. The project was stopped, and I know of no order being placed for the AD–X2.

The CHAIRMAN. So you have not been using the product at all?

Mr. WALKER. No, sir; we have not been using the product.

The CHAIRMAN. Did anybody brief you or discuss this with you at all before you came here?

Mr. WALKER. When I left Sacramento I reported into the Pentagon to let them know I was here; the teletypes came through Major Ranz' office, and they only wanted to know if my file was complete.

The CHAIRMAN. They only wanted to know whether your file was complete?

Mr. WALKER. Yes; if my file was complete, and if I had the necessary papers with which to come up here.

The CHAIRMAN. The report that was submitted to the committee at an earlier time recommends that the War Department Technical Manual TM–9–2857 be revised.

Mr. WALKER. Yes, sir.

The CHAIRMAN (reading):

18. Thus far battery additive AD–X2 with the trade name of Protecto-Charge, has proven there is a very definite effect of added salts on the physical properties of lead sulfate, as it is precipitated in the storage cell.

Mr. WALKER. That is correct.

The CHAIRMAN. I beg your pardon?

Mr. WALKER. This is in report No. 4.

The CHAIRMAN. Yes. "This process involves the addition of a powder mixture of," and so forth. [Reading:]

The results are quite different from that when the equivalent amounts of sodium sulfate and epsom salts are used. The active material remains tight to the grid in a soft condition and there is little shedding of the active material so that there is an apparent decrease in the amount of battery mud. The tightness of the active material to the grid results in less gassing on charging, very small bubbles distributed on the surface of the plates, rather than at the location of the grids. This feature is advantageous to the lead-acid battery. The above recommendations are made with this in view.

That does not just exactly coincide with what you said.

Mr. WALKER. Those are my recommendations.

The CHAIRMAN. I beg your pardon?

Mr. WALKER. I say, they are my recommendations.

The CHAIRMAN. But you just said that your test had been so short and so inclusive that you could not make a comment whether you would have bought the powder or not if it was out of your own pocket. I just wanted to be sure that your report was the same as the report that had been filed at an earlier date, and I wanted to be certain why you had such apparent reservations now, and that those same apparent reservations were not in the original report. I was just wondering about it—not that it makes a bit of difference to me, only that you are under oath.

Mr. WALKER. Definitely, sir.

The CHAIRMAN. And what you are going to say here, I just wanted to be sure that your statements here would somewhere coincide with the printed statement that had been submitted at an earlier time.

Mr. WALKER. May I call your attention to the recommendation prior to that regarding the subject.

Authorize this command to treat all automotive-type batteries in active use at this base, with Protecto-Charge. Once every 30 days spot check for general condition and general battery troubles that the layman experiences in the field. Subject 2 each 6-volt batteries and 2 each 12-volt batteries to a 200-ampere load until an average cell voltage of 1.5 is reached, then spot check the batteries for their rate of recovery.

That is another field test I would have liked to run for some confirmation of my findings prior to the date of this recommendation.

The CHAIRMAN. Have you any further comment?

Mr. WALKER. No, sir; I haven't.

The CHAIRMAN. You have no further comments at this time? You mean you have concluded your statement?

Mr. WALKER. I have read my report, sir.

The CHAIRMAN. You have read your report; then you have concluded your statement? I was just waiting for you to continue.

Mr. WALKER. I would also like to read paragraph f. To summarize that the point was that I would still have liked to run further service tests over a year's period on quite a few vehicles and to watch them and to see how they operated; this is what I would have liked to do.

The CHAIRMAN. You would have liked to run further tests on it to have brought it out in further detail?

Mr. WALKER. Yes, sir; that is on the point where you asked me what my opinion was, and I stated I would like to run further tests.

The CHAIRMAN. But you were not ordered to be careful with what you said around here, were you?

Mr. WALKER. Not that I recall, sir.

The CHAIRMAN. You are so hesitant and your remarks do not coincide with this report. I am just a little bit concerned.

Mr. WALKER. I am a little nervous.

The CHAIRMAN. Not that it makes a bit of difference to me; you are free, but you hesitate so much that it is disturbing to me.

Mr. WALKER. May I clarify a point here? I had a very serious speech impediment when I was a young man——

The CHAIRMAN. Then, I beg your pardon.

Mr. WALKER (continuing). And I stutter very, very seriously when I get frustrated. Please, I do not like to stutter.

The CHAIRMAN. Then I beg your pardon, sir. But your remarks did not coincide with these reports that were submitted to the committee here. Here are the two of them, and there are some definite conclusions in these paragraphs, and we will let counsel read those so that I am not reading them. Let the counsel read these more or less concluding paragraphs. I am just trying to help you, but it does not do any good to have you come here from California, to come here and then not make a report that coincides with a printed statement that has been submitted.

Mr. WALKER. May I read my recommendations at the end of each report then for the committee?

The CHAIRMAN. Certainly.

Mr. WALKER. I would like to.

The CHAIRMAN. Yes, sir.

Mr. WALKER. Thanks very much.

In report No. 1, the recommendation is:

The following revision is recommended on service test project P–893–SC—

that is the first report, page 6—

One new 6-volt battery and one new 12-volt battery be subject to the following tests.

Then it outlines a 40-ampere-hour life cycle test.

In the first part of the test report on test No. 2, the report reads:

The present 6 VA and 6 VB batteries have been transferred to the 40-ampere life test and will be referred to in this and future correspondence—

as so and so; in other words, I started—all that paragraph states is that I started the life cycle tests.

The CHAIRMAN. Now, I thought you were going to read your remarks that are found in these reports here that were submitted. If you are not going to read it, then I think that counsel here might well read those to see if your opinion differs with what is typed in these reports here.

Mr. WALKER. My opinion does not differ from what I have put down into these reports; they do not.

The CHAIRMAN. Let us read these reports, these paragraphs that appear. In this report it is 18 on the yellow slip and it is page what in the loose sheets?

Senator SMATHERS. Mr. Chairman, has it been established that this man wrote these reports?

Mr. WALKER. Yes, sir; I did write the report.

Senator SMATHERS. You did write these reports.

Mr. WALKER. Yes.

The CHAIRMAN. I am just trying to help him through this report and these concluding paragraphs here. You may proceed to read that.

Mr. FORSYTHE. Mr. Walker, we are just trying to clear something up here. On October 30, 1948, we find this notation of that date in the report handed to the committee by the Air Force through proper channels, and let me just read you some of these remarks. There is no page here, Senator; it is in the blue one; it is not numbered.

Senator SMATHERS. Page 7 is the last one.

Mr. FORSYTHE. That is the other one the Senator read. There is no number on the page. Anyway it says this in one part:

The Protecto-Charge cell is still in very good condition and has very good capacity as the breakdown test shows.

I assume that is correct?

Mr. WALKER. That is correct. May I background that battery?

Mr. FORSYTHE. Yes, certainly.

Mr. WALKER. That is a battery that had a Protecto-Charge treated cell, another cell with, I think, magnesium and sodium sulfate added, and that is the background on this battery.

Mr. FORSYTHE. What kind of a solution was added?

Mr. WALKER. Magnesium and sodium sulfate were added in the other cell.

Mr. FORSYTHE. In another cell?

Mr. WALKER. In the other cell; yes.

Mr. FORSYTHE. I have a paragraph marked 3, I do not know whether you have been following, Mr. Walker, and I may have to show you this report, but it starts out as No. 3, and you say:

It has been observed that this type of battery additive—

Is that referring to Protecto-Charge?

Mr. WALKER. Will you continue reading that?

Mr. FORSYTHE. Yes—

affects the active material of a lead-acid storage battery because of the fact that it alters the crystal growth of the lead sulfate as it is formed. This is recognized at the time of internal inspection of the batteries and observation of glass cells.

Mr. WALKER. Yes.

Mr. FORSYTHE (reading):

Sulfation does form but in small spots that are grainy in appearance and very white. It is a definite fact that this type of additive slows up the rate at which lead sulfate crystals grow, also the way in which they grow, as if small crystals of salt. Upon inspection of the plates, the active material of the positive plates is tight against the grid and when overcharging small bubbles appear on the surface of the active material. It is these bubbles which form at the grid of an untreated battery that is responsible for the shedding of the active material. These bubbles are fine and appear at the surface of the active material of a treated battery, it is this feature which prevents shedding of the active material from the grids.

Mr. WALKER. That is correct. May I elaborate on that one point?

Mr. FORSYTHE. Yes.

Mr. WALKER. Where it says about the sulfation crystals?

Mr. FORSYTHE. Yes.

Mr. WALKER. In a normal battery when it is sulfating you will have sulfate crystals growing that look like cat's whiskers. In my observations in 1948 with a treated battery you would not have those long cat's-whisker sulfate crystals form, but, as I referred to in my report, you

would have small spots. These fine little round spots were scattered over the plate; also the bubbles—instead of, as on an untreated cell, the bubbles that form during the charging and discharging cycles—instead of being large were small and when the large bubbles explode at the grid they would carry off a large amount of material. I found we only had fine bubbles on our treated batteries. Now, that is the general gist of that sentence outlining that viewpoint which I observed.

Mr. FORSYTHE. All right.

Then, on the same report, paragraph 15, you say:

Thus far on the additive breakdown test Protecto-Charge, now known as AD–X2, is the only additive that will go beyond step 7 as outlined.

Will you explain that?

Mr. WALKER. That is absolutely correct. That is the only one that would go beyond step 7, and may I refer back to one of my reports? The additive breakdown test is in there and the committee, I believe, can evaluate that particular point of the charging cycle. It is just a matter of the charging and discharging cycle that that battery was going through, and the Protecto-Charge, or AD–X2, was the only one that would go down past step 7 as outlined in my report, which was made available to the committee.

Mr. FORSYTHE. You say also on the top of the next page:

The positive plates—

this is in reference to the Protecto-Charge, AD–X2-treated cells, the same that I read before—

The positive plates were soft and rich brown in color with no apparent signs of shedding. Negative plates were very grainy, with the active material separated from the grid. Negative plates showed a complete breakdown, 25 percent—

and so forth, and then you go on with your description of the cells.

Mr. WALKER. Then that describes the cell, I believe?

Mr. FORSYTHE. That is correct. Does that statement correspond with yours?

Mr. WALKER. That statement corresponds with what I gave the committee.

Mr. FORSYTHE. Yes.

Mr. WALKER. It is contained in my full report and, as I stated, it was turned over to the committee.

Senator SMATHERS. May I interrupt counsel to ask this question right there in reading those sentences? It says:

Negative plates were very grainy, with the active material separated from the grid; negative plates showed a complete breakdown and 25 percent of the active materials had shed away from the grid. At this point battery additive type 11 is considered of no value to the lead-acid type battery.

Mr. FORSYTHE. Is that Protecto-Charge or AD–X2?

Mr. WALKER. I believe the code there is PC; is that correct?

Senator SMATHERS. This is all in this very same report. Were you running a test on type 11 or were you running a test on AD–X2?

Mr. WALKER. As I recall and as I pointed out a moment ago, I had this battery treated—the battery had 3 cells, and 2 of the cells were treated with various percentages of sodium and magnesium sulfate. The third cell was treated with Protecto-Charge.

Senator SMATHERS. I see.

Mr. WALKER. The battery was operating, and those are the detailed reports as to time, voltage, gravity and, in other words, what is the

battery doing as it discharges, as it charges, and then the statement that the Protecto-Charge was the only one that would go past step No. 6, as I recall, or is it 7—6 or 7?

Mr. FORSYTHE. It is 7.

Mr. WALKER. In the referenced breakdown test, in the report.

The CHAIRMAN. Do you wish to ask him some questions?

Mr. WALKER. Mr. Chairman, for the matter of the record, my opinion has not changed on my report since I compiled and sent the report in.

Mr. FORSYTHE. The only reason I asked was that the report indicates here at several places, some of which we have read, a rather specific comparison of AD–X2 with other compounds that you mixed in relation to sulfation, which is part of the test that you made.

Mr. WALKER. Definitely so, sir.

Mr. FORSYTHE. It indicates that AD–X2 was more effective in breaking up the crystals and not allowing shedding. That is the only thing we are trying to get at.

Mr. WALKER. That point is absolutely correct, and my test that I conducted in that line, as you will see in the detailed report, explains in detail how that happens, although I appreciate the fact that it is on only one battery that this test was conducted, and again——

The CHAIRMAN. You mean where you used different additives?

Mr. WALKER. Yes.

The CHAIRMAN. Only in the one battery where you used the different additives?

Mr. WALKER. It is only on the one battery; yes, sir. I believe there is another recommendation in my report that I would like to conduct further tests for confirming my findings. I believe that is correct, and is in there.

The CHAIRMAN. Senator Sparkman?

Senator SPARKMAN. No questions.

The CHAIRMAN. Senator Smathers?

Senator SMATHERS. Just one question. On this matter of eliminating the breaking up of the crystals and the eliminating of the sulfation, as you described it, did you consider that of major importance in the power and in the life of the battery?

Mr. WALKER. It is of major importance in the point of what is known as local action or the battery self-discharging. If those long cat-whisker sulfation crystals form, it means it will short the positive and negative plates out, just the same as if you take a lamp cord and cut it with a knife, you will short the lamp cord out; you will do the same thing in the cell with these sulfation crystals.

Now, by adding this additive it changed the way that the crystals grew. It was my observation, that it actually changed the way that crystals grew.

Senator SMATHERS. Well, in changing the way the crystals grew, did it eliminate the crystal?

Mr. WALKER. It eliminated this one factor. It would grow, as I describe in my report, as small-spot sulfation over the plate.

Senator SMATHERS. But you still had some crystals there?

Mr. WALKER. There apparently were white crystals—I shouldn't say white crystals, but white spots of sulfation on the battery plates.

Senator SMATHERS. As I understand it, your final conclusion is that these tests were inconclusive?

Mr. WALKER. Yes, they should have been conducted over a longer period of time for confirmation of my findings.

The CHAIRMAN. Any further questions?

Mr. FORSYTHE. Mr. Walker, just to clear the record, and getting away from AD–X2, in your reports here on this matter of sulfation, if you find anything that breaks up a sulfated crystal and allows the crystal to soften or to break up, and yet does prevent shedding at the bottom of the battery, that is, according to this report and others we have, if anything does that, that would be what you would call an effect, a good one, in a lead-acid storage battery?

Mr. WALKER. That is one of the effects we were looking at, and it was that particular effect you are describing.

Mr. FORSYTHE. In other words, your test was geared partly to testing these additives in reference to the action in breaking up sulfation, and in the shedding process.

Mr. WALKER. It was to see what distinct and different-type additives would do.

The CHAIRMAN. Have you anything further to say, Mr. Walker?

Mr. WALKER. Not unless the committee would like me to read my report.

The CHAIRMAN. All right.

Now, Mr. Beene, you may proceed, and you may proceed in whatever manner you desire.

TESTIMONY OF JAMES C. BEENE, INDUSTRIAL ENGINE GENERAL ASSEMBLY FOREMAN, SAN ANTONIO AIR MATERIEL AREA, KELLY AIR FORCE BASE, SAN ANTONIO, TEX.

Mr. BEENE. I am James C. Beene from the San Antonio Air Materiel Area, Kelly Air Force Base, at San Antonio, Tex.

The CHAIRMAN. What are your duties there, Mr. Beene?

Mr. BEENE. I am an industrial engine assembly general foreman.

The CHAIRMAN. You are an industrial engine general assembly foreman?

Mr. BEENE. Yes, sir.

The CHAIRMAN. Do you have the responsibility of storage batteries?

Mr. BEENE. I do not now, Mr. Chairman.

The CHAIRMAN. You do not now?

Mr. BEENE. No, sir.

The CHAIRMAN. Did you have that responsibility?

Mr. BEENE. In 1948 when we conducted these tests, that was my responsibility.

The CHAIRMAN. The battery servicing was your responsibility?

Mr. BEENE. Yes, sir; it was under my supervision.

The CHAIRMAN. How many batteries would come through the shop for which you are responsible?

Mr. BEENE. I would be unable to answer that without referring to the records.

The CHAIRMAN. Then they ran into hundreds, is that the answer?

Mr. BEENE. Yes, sir; they would run into the hundreds.

The CHAIRMAN. All manner of batteries, airplane and automotive?

Mr. BEENE. Only automotive.

The CHAIRMAN. Only automotive?

Mr. BEENE. Yes, sir.

The CHAIRMAN. You may proceed, sir.

Mr. BEENE. In May 1948, I received a project directive from Headquarters, Air Materiel Command, to test battery additive AD–X2, which is also known as Protecto-Charge, at Kelly Air Force Base, Tex., and the same directive as Mr. Walker read is the one I followed—the project directive which gave us instructions on how to conduct this test, is the directive that was followed.

I selected 10 mechanically sound but sulfated batteries from salvage. The batteries were inspected very carefully internally for any defects and foreign matter. Plates were not buckled or separators cracked.

The batteries were reassembled, and water was added to bring the level of the electrolyte over the top of the plates. Two new dry charged batteries of the types designated in the directive were procured from stock. Electrolyte with specific gravity as recommended by the manufacturer was added to these two new batteries. Battery terminals and covers of the 12 batteries were thoroughly cleaned; AD–X2 in the amount recommended by the manufacturer was added to each battery. All batteries were connected to the charging line, and assurance was made that an approximate 4-ampere charge was passing through the batteries.

During the period of from 3 to 15 days, 10 of the batteries were placed in various types of ground equipment, and 2 batteries were held in the shop, as per instructions.

Three of these batteries, that is three of the old batteries, failed in the first reporting period as indicated on report, as of the 15th of July 1948, and these reports are made available to the committee.

Reports were submitted each 15-day period, giving the status of the treated batteries. The last report was submitted October 31, 1948.

The 2 new batteries and 1 old battery were still in service at the expiration of these tests. The remaining nine batteries failed.

At the time of each battery failure, the battery was completely disassembled to determine the cause of failure. The service tests reflect the causes for those failures.

The CHAIRMAN. What were the causes of the failure? You do not have the information right there at hand, do you?

Mr. BEENE. Yes, sir; I do. In most all cases, Mr. Chairman, the failure was the same, it was the material shedding from the positive plates all the way through—either the positive or the negative plates; in the majority of all cases, though, it was the positive—material shedding from the positive plates.

I concluded from this service test conducted in 1948 that AD–X2 is unsatisfactory for the application as outlined by the authorizing directive.

The CHAIRMAN. Then you could see no benefit from it, and if it was your own battery and your own money you would not have spent the money?

Mr. BEENE. No, sir.

The CHAIRMAN. Senator Sparkman.

Senator SPARKMAN. No questions, Mr. Chairman.

The CHAIRMAN. Senator Smathers?

Senator SMATHERS. I gather that you would not have spent your own money at any time buying this AD–X2?

Mr. BEENE. I would not.

Senator SMATHERS That is all.

The CHAIRMAN. You ran that test about how long?

Mr. BEENE. 120 days.

The CHAIRMAN. 120 days?

Mr. BEENE. As outlined in the project directive.

The CHAIRMAN. Is this the entire report that you are submitting.

Mr. BEENE. I believe that is the complete report, sir.

The CHAIRMAN. This is a photostatic copy of it.

Mr. BEENE. Yes, sir.

(The document referred to follows:)

HEADQUARTERS, SAN ANTONIO AIR MATERIEL AREA,
KELLY AIR FORCE BASE,
San Antonio, Tex., 6 Aug. 1948.

SAAMA 412.42.

Subject: Service Test Report of Project P–892–SA.

To: Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Wright Field, Ohio.

(Attention: MCMMXT—53.)

1. In compliance with MCMMXC–12–5–181, dated 18 May 1948, and MCMMXC–12–7–405, dated 27 July 1948, submitted herewith, are subject reports in duplicate for 15 July 1948 and 1 August 1948.

2. Subsequent reports will be submitted on the first and fifteenth of each month until this project is completed.

For the Commanding General:

L. J. MILHAN
(For F. Bell, Colonel, USAF, Director, Maintenance).

1 Incl: Service Test Report of Project P–892–SA (Duplicate).

Service test report of project P–892–SA

Battery	Gravity			Voltage			Date of inspection
As of July 15, 1948:							
B–6	1.280	1.290	1.290	1.5	1.4	1.5	July 15, 1948
C–6	1.275	1.270	1.265	1.8	1.8	1.9	Do.
D–6	1.300	1.300	1.300	1.6	1.4	1.6	July 16, 1948
E–6	1.250	1.250	1.250	1.4	1.4	1.4	July 15, 1948
F–6	1.290	1.280	1.290	1.6	1.4	1.6	Do.
A–6	1.250	1.260	1.250	1.4	1.4	1.4	July 16, 1948
A–12	1.250	1.270	1.270	1.4	1.4	1.4	Do.
	1.270	1.270	1.270	1.4	1.4	1.4	
B–12	1.260	1.270	1.270	1.5	1.5	1.5	Do.
	1.275	1.275	1.275	1.5	1.5	1.5	
C–12	(1)	(1)	(1)	(1)	(1)	(1)	Do.
D–12	1.275	1.275	1.275	1.5	1.5	1.5	Do.
	1.260	1.270	1.270	1.5	1.5	1.5	
E–12, F–12	(2)	(2)	(2)	(2)	(2)	(2)	Do.
As of Aug. 1, 1948:							
B–6	1.250	1.250	1.270	1.6	1.6	1.6	Aug. 1, 1948
C–6	1.250	1.275	1.250	1.6	1.6	1.6	Do.
D–6	1.275	1.275	1.275	1.6	1.4	1.6	Do.
E–6	1.250	1.250	1.250	1.4	1.4	1.4	Do.
F–6	1.290	1.280	1.290	1.6	1.4	1.6	Do.
A–6	1.250	1.250	1.275	1.4	1.4	1.4	Do.
A–12	1.275	1.275	1.275	1.6	1.5	1.6	Do.
	1.250	1.250	1.250	1.4	1.4	1.4	
B–12	1.250	1.225	1.250	1.5	1.5	1.3	Do.
	1.225	1.275	1.230	1.5	1.6	1.6	
C–12	(1)	(1)	(1)	(1)	(1)	(1)	July 16, 1948
D–12	1.275	1.275	1.275	1.5	1.5	1.5	Aug. 1, 1948
	1.260	1.270	1.270	1.5	1.5	1.5	
E–12, F–12	(2)	(2)	(2)	(2)	(2)	(2)	July 16, 1948
As of Sept. 1, 1948:							
B–6	(3)	(3)	(3)	(3)	(3)	(3)	Aug. 16, 1948
C–6	(4)	(4)	(4)	(4)	(4)	(4)	Do.
D–6	1.275	1.275	1.275	1.6	1.6	1.6	Aug. 31, 1948
E–6	(3)	(3)	(3)	(3)	(3)	(3)	Aug. 16, 1948
F–6	1.275	1.270	1.275	1.5	1.4	1.5	Aug. 31, 1948
A–6	1.260	1.260	1.275	1.5	1.5	1.5	Do.
A–12	1.275	1.275	1.275	1.5	1.5	1.5	Do.
	1.270	1.270	1.270	1.5	1.5	1.5	
B–12	1.250	1.240	1.230	1.4	1.4	1.3	Do.
	1.225	1.200	1.200	1.3	1.2	1.2	
C–12	(4)	(4)	(4)	(4)	(4)	(4)	July 16, 1948
D–12	1.260	1.265	1.260	1.5	1.5	1.5	Aug. 31, 1948
	1.260	1.260	1.260	1.5	1.5	1.5	
E–12, F–12	(2)	(2)	(2)	(2)	(2)	(2)	July 16, 1948

[1] Battery failed and was opened and positive plates were found to be worn out and crumbled.
[2] Batteries failed and were found to be no good. Material shedded from grids.
[3] Battery failed, was opened, and positive plates were found to be crumbled.
[4] Battery failed. Material had shedded from positive grids.

NOTE.—Batteries F–6 and B–12, E–6 and D–12, D–6 and D–12 were subjected to heavy load and found to be O. K.

17 September 1948
SAMPC/WTC/cev

SAAMA 412.42

Subject: Service Test Report of Project P–892–SA.
To: Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio.

(Attention: MCMMXT–53.)

In compliance with MCMMXC–12–5–181, dated 18 May 1948, and MCMMXC–12–7–405, dated 27 July 1948, submitted herewith is subject report in duplicate for 15 September 1948.

For the Commanding General:

F. BELL,
Colonel, USAF,
Director, Maintenance.

1 Incl: Service Test Report of Project P–892–SA (Duplicate).

Service test report of project P–892–SA

[As of Sept. 15, 1948]

Battery	Gravity			Voltage			Date of inspection
B–6	(1)	(1)	(1)	(1)	(1)	(1)	Aug. 16, 1948
C–6	(2)	(2)	(2)	(2)	(2)	(2)	Do.
D–6	1.250	1.250	1.225	2.5	1.2	1.2	Sept. 14, 1948
E–6	(1)	(1)	(1)	(1)	(1)	(1)	Aug. 16, 1948
F–6	(1)	(1)	(1)	(1)	(1)	(1)	Sept. 14, 1948
A–6	1.250	1.275	1.250	1.5	2.2	2.2	Do.
A–12	1.250	1.275	1.275	2.5	2.2	2.2	Do.
	1.275	1.275	1.275	2.5	2.5	2.2	
B–12	(3)	(3)	(3)	(3)	(3)	(3)	Sept. 15, 1948
C–12	(2)	(2)	(2)	(2)	(2)	(2)	July 16, 1948
D–12	(4)	(4)	(4)	(4)	(4)	(4)	Sept. 15, 1948
E–12, F–12	(5)	(5)	(5)	(5)	(5)	(5)	July 16, 1948

[1] Battery failed, was opened, and positive plates were found to be crumbled.
[2] Battery failed. Material shedded from positive grids.
[3] Battery failed; positive plates were crumbled.
[4] Battery failed; positive plates worn out and crumbled.
[5] Batteries failed and were found to be no good. Material shedded from grids.

NOTE.—Battery D–6 was subjected to heavy load and was found to be O. K. Battery D–12 failed to stand up.

6 Nov. 1948.

SAAMA 412.42.

Subject: Service Test Report of Project P–892–SA.

To: Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio.

(Attention: MCMMXT–53.)

In compliance with MCMMXC–12–5–181, dated 18 May 1948, and MCMMXC–12–7–405, dated 27 July 1948, submitted herewith is final report in duplicate. Project was completed 28 October 1948.

For the Commanding General:

F. BELL,
Colonel, USAF,
Director, Maintenance.

1 Incl: Service Test Report of Project P–892–SA (in dup.).

Service test report of project P–892–SA

[As of Oct. 31, 1948]

Battery	Gravity			Voltage			Date of inspection
B–6 [1]							Aug. 16, 1948
C–6 [2]							Do.
D–6	1.240	1.260	1.200	1.5	1.5	1.5	Nov. 1, 1948
E–6 [1]							Aug. 16, 1948
F–6 [1]							Sept. 14, 1948
A–6	1.200	1.260	1.260	1.8	1.8	1.8	Nov. 1, 1948
A–12	1.300	1.300	1.300	1.5	1.5	1.5	Do.
	1.300	1.300	1.300	1.5	1.5	1.5	
B–12 [3]							Sept. 15, 1948
C–12 [2]							July 16, 1948
D–12 [3]							Sept. 15, 1948
E–12 [4]							July 16, 1948
F–12 [4]							

[1] Battery failed, was opened, and positive plates were found to be crumbled.
[2] Battery failed. Material shedded from positive grids.
[3] Battery failed, positive plates worn out and crumbled.
[4] Batteries failed and were found to be no good. Material shedded from grids.

The CHAIRMAN. I notice here the battery failed, and it was opened, and the positive plates were found to be worn out and crumbled.

Mr. BEENE. That is right.

The CHAIRMAN. That was on the C–12, and I see here on this statement:

NOTE.—Battery D–6 was subjected to heavy load and was found to be O. K. C–12: Battery failed and was opened and positive plates were found to be worn out and crumbled.

That must be the same as I had read up above—no, one was of July 15, and the other date was August 1.

Had you checked these batteries to determine whether they were sound before you put the additive in?

Mr. BEENE. Yes, sir.

The CHAIRMAN. They were sound?

Mr. BEENE. Yes, sir.

The CHAIRMAN. Where did you get those batteries?

Mr. BEENE. From salvage.

The CHAIRMAN. You took them out of salvage?

Mr. BEENE. We took the old batteries out of salvage; the 10 old batteries were taken from salvage.

The CHAIRMAN. How long had they been in salvage?

Mr. BEENE. That I do not know.

The CHAIRMAN. But you just took them out of the salvage dump?

Mr. BEENE. Yes, sir.

The CHAIRMAN. Did they have water in them when you took them?

Mr. BEENE. Some had some water, as well as I recall, and—well, they had varying amounts, I would say.

The CHAIRMAN. Were any of them without caps on them when you took them out of the salvage dump?

Mr. BEENE. To the best of my recollection they all had caps on them.

The CHAIRMAN. They all did have?

Mr. BEENE. Yes, sir.

The CHAIRMAN. But you have no knowledge how long they had been in the salvage dump when you took them out and put them on the line. How long did you charge them before you put the additive in?

Mr. BEENE. I did not charge the battery—that is, the 10 old batteries—before I put the additive in.

The CHAIRMAN. You did not?

Mr. BEENE. No, sir.

The CHAIRMAN. You just took them, brought the water up above the plates?

Mr. BEENE. I first disassembled the old batteries, Mr. Chairman, to see that they were mechanically sound.

The CHAIRMAN. I see.

Mr. BEENE. In other words, they were sulfated; but to see that they were mechanically sound otherwise, that is, that the plates were not buckled or the separators split.

The CHAIRMAN. I see. How long did it take before these 12 failed; how long had they been in use?

Mr. BEENE. That test was started the 1st of July, so that is when the battery additive was added. This C–12 battery failed on the 16th of July.

The CHAIRMAN. The 16th of July?

Mr. BEENE. Yes, sir.

The CHAIRMAN. You think that that battery would have failed no matter whether you had put the compound in or whether you had not put it in?

Mr. BEENE. Very definitely it would have.

The CHAIRMAN. I beg your pardon?

Mr. BEENE. It would have failed.

The CHAIRMAN. Why?

Mr. BEENE. It would have failed whether it had the compound in or not.

The CHAIRMAN. Would you think it was just the hardness of the cell; I mean the condition that the plates were in, that they were so hard that any vibration was apt to cause them to crumble?

Mr. BEENE. Yes, sir.

The CHAIRMAN. Those are all the questions that I have.

Thank you, gentlemen. We appreciate the fact that you came in.

Our next witness is Mr. Kenneth Binding, of the Market Forge Co., of Everett, Mass.

Mr. Binding, raise your right hand. Do you swear that the testimony you are about to give pertaining to the matter now before this committee is the truth, the whole truth, and nothing but the truth, so help you God?

Mr. BINDING. I do.

TESTIMONY OF KENNETH W. BINDING, EXPERIMENTAL AND DEVELOPMENT ENGINEER, MARKET FORGE CO., EVERETT, MASS.

The CHAIRMAN. You may proceed in any manner you desire.

Mr. BINDING. My name is Kenneth W. Binding.

The CHAIRMAN. Will you tell the committee the position that you hold or what your business is, and so on and so forth?

Mr. BINDING. Yes, sir. I am an experimental and development engineer with the Market Forge Co. I develop new products, carry on all the experimental work that happens to come my way.

I was told this was going to be a very informal report, so I have no prepared statements, just my humble story.

The CHAIRMAN. Well, Mr. Binding, this is informal. We are trying just to get information, good or bad. We are trying to make a record in order to make a decision, and you may proceed to tell us just what you want to tell us.

If it will help you, could I ask you this question: Have you worked with batteries?

Mr. BINDING. Off and on, but nothing in particular. I am not a battery expert.

The CHAIRMAN. You are not a battery expert?

Mr. BINDING. No.

The CHAIRMAN. You have never done any service work on batteries?

Mr. BINDING. None whatsoever.

The CHAIRMAN. Then, upon what do you base what you are going to say? Are you going to talk about your experience with the additive or are you going to tell what you think about it?

Mr. BINDING. Both.

The CHAIRMAN. O. K.

Mr. BINDING. I design and develop industrial equipment that uses electric storage batteries of many types. I have been doing that for a number of years.

I am going to tell you my first experience which was about a battery back about in December of 1951. I had a battery—at that time it was at least 5 years old.

The CHAIRMAN. Was that an automobile battery?

Mr. BINDING. No; that was a heavy industrial-type battery, a 340-ampere-hour, 12-volt industrial truck battery.

The CHAIRMAN. Truck battery?

Mr. BINDING. Industrial truck battery.

The CHAIRMAN. I see. What is the cost of that battery?

Mr. BINDING. That battery is in the neighborhood of between five and six hundred dollars.

The CHAIRMAN. What is the average life of such a battery, or we will put it this way: What is the manufacturer's life guaranty on a battery like that?

Mr. BINDING. Well, they usually are—they will give you a year's guaranty, that is, not an unconditional guaranty, it is a year's guaranty, providing it is well taken care of.

The CHAIRMAN. Of course, such an industrial battery would have reasonably good care because it comes under the supervision of a shop engineer.

Mr. BINDING. That is right. It is a valuable piece of equipment and, naturally, it is taken care of because if you don't take care of them you don't get performance.

Now, this particular battery I had used for a lot of my experimental work. It had been used for 3 years continuously, probably on the average of working 8 hours, 8 hours on charge, and back 8 hours on duty again.

Of course, I had many other batteries of the same type as the years went by.

Back in 1951, in December 1951, the local representative for this battery additive came to me and told me what he had. I was somewhat skeptical about the whole procedure, but being of a curious nature, as Dr. Weber, and having an open mind, I was very willing to go ahead and give this material a try, disregarding all reports that I had heard about the material, pro and con.

I let Mr. Goodwin, who happened to be the fellow involved in this affair, treat this battery. This was a battery that had been laying idle for 1 year, because the year previous to December 1951 the battery was not functioning the way it should.

I didn't need the battery, I had plenty of other new batteries to use, so it was put to one side.

In November 1951 I decided that the battery, being no longer serviceable, I might as well get it out of my way. The battery manufacturer examined the battery and recommended its discard; it was absolutely useless. I agreed with him, of course, because I could not get a charge into that battery that would last more than—it would discharge itself without being used in a matter of 2 hours after—it would get a partial charge on it.

I had issued orders to have that battery go out as junk, and was to be paid $29 for the battery.

So Mr. Goodwin came along and offered to treat that battery on the condition that if he didn't do it any good I didn't owe him any money. So I had nothing to lose and I had everything to gain. So, being of a curious nature I said, "We will proceed," which we did.

Mr. Goodwin treated the battery himself personally. I was with him. He ran through the usual procedure recommended for that type of a setup.

We put the battery on slow charge afterward. We didn't know whether the battery was mechanically sound or not, we were taking a chance. We had no way—we didn't want to tear the battery down to make any observation.

The battery was treated; I partially charged it, I put it on a resistance, and ran the thing down, discharged it, cycled it back and forth—that is, I charged it and then discharged it—so that at the end of a week I had that battery back up to almost the battery manufacturer's specifications as far as specific gravity went, and the battery was taking a good charge.

We put the battery in service on a truck that was being used, and much to our surprise this particular battery held up very well. I didn't expect it——

The CHAIRMAN. What date and year did you put it back into service?

Mr. BINDING. That went back into service in December 1951.

The CHAIRMAN. December 1951?

Mr. BINDING. 1951.

The CHAIRMAN. Where is it now?

Mr. BINDING. It is still in the factory, still being used.

The CHAIRMAN. Still in use?

Mr. BINDING. Still in use, still doing a good day's job. I checked the battery myself Tuesday before I came down here.

The CHAIRMAN. What did it cost you to put the additive in the battery?

Mr. BINDING. After 3 months' time, I finally accepted the bill, and O.K.'d it and paid the money for the material. I think it was around $35, $36, as I remember it.

The CHAIRMAN. And the value of that battery is what?

Mr. BINDING. At least $500.

The CHAIRMAN. $500; and this was December of 1951 that it went back into service after the manufacturer had said it should be junked?

Mr. BINDING. That is right. Now, since this battery went into service, it has been inspected by the battery manufacturer in that we have had it propped, what they call, to determine whether it had any sulfated sedimentation on the bottom, and up until a month ago it was perfectly free from any sulfation settling on the bottom of the cells which would cause it not to function; and the battery now is doing a full day's work. It is keeping up as far as I can tell for all practical purposes; it is perfectly satisfactory.

Since then, of course, I have treated other batteries; I have treated at least 7 industrial batteries; perhaps they were in a much better condition than the first 1.

The CHAIRMAN. Are they all in your shop?

Mr. BINDING. They are.

The CHAIRMAN. How many batteries do you have as a total?

Mr. BINDING. Well, probably at least a dozen or 15, industrial-type heavy-duty batteries. I have always treated a good many of our automotive batteries, used them in crane cars and gasoline industrial trucks, and all of my experience has been, as I say, of a miraculous nature—that is the only way I can say it.

I don't understand it. I don't profess to know what happens. All I know is that as far as I was concerned I was amazed, and I was criticized somewhat at the beginning because, after all, everyone said it was a lot of nonsense, but I have lived long enough, I have conducted enough experiments and developing, to know that no one, I think, has a right to say anything can't be done. That is impractical, because as sure as you do, later on you wish you had never said those things.

The CHAIRMAN. What was your normal battery cost per year?

Mr. BINDING. Normal——

The CHAIRMAN. I mean, such as replacements, if you have that many batteries, there would usually be a turnover.

Mr. BINDING. That is right. We have—there is a turnover in batteries. Of course, we have accidents. Batteries become physically damaged in collisions, and equipment turning over, and that sort of thing.

The CHAIRMAN. But I mean in the plant where you have these big ones; automobile batteries, you can be careless in taking a cable off or putting another cable on, and tap them so hard that you break the post loose from the internal units.

Mr. BINDING. That is right.

The CHAIRMAN. I have seen my men do that.

Mr. BINDING. That is right.

The CHAIRMAN. And I had to pay the bill.

Mr. BINDING. That is right; and that sort of thing happens to industrial batteries exactly the same way. They can be repaired—it is nothing but what can be fixed up, and they are serviceable.

The CHAIRMAN. That is why I was getting at whether you had figures on your big industrial batteries in the plant so that you could tell us in dollars and cents your annual cost and maintenance of those big batteries in the plant, the automobile batteries are—or is that not so easily ascertained?

Mr. BINDING. Well, offhand, I would say that in the period since 1951, I probably would have had to replace—I would say offhand that we, as a rule, have had to replace, perhaps, 2 or 3 batteries out of the dozen each year; I mean, that is just the accepted replacement percentage that we sort of go on. But we have not—I have not—had to buy a new battery for the last 6 months other than new equipment that went into service.

The CHAIRMAN. In other words, in replacement you have not bought any new ones in 6 months?

Mr. BINDING. I have not; not on present equipment that is working, and I am sure I would have if I had not—and all batteries are treated this way, and I have especially 3 other batteries besides the original 1 that I definitely know I would have had to replace within the last year and a half.

The CHAIRMAN. If you had not put the additive in?

Mr. BINDING. That is right; because when they were treated they were getting to the point where they were becoming a nuisance, and

had to be charged often and you couldn't get 8 hours of work out of them. You could, perhaps, get a half-day's work, and you had to put them back on charge.

The CHAIRMAN. What does it normally cost to charge one of those batteries?

Mr. BINDING. Well, it would depend on the charging equipment you used. It would depend on whether they used a rectifying type of charger or a generator type. Of course, it costs money to put energy back into a battery.

The CHAIRMAN. That is what I was getting at. Roughly what was the cost of putting that energy back into the battery after it had been run down over that 8 hours of usage?

Mr. BINDING. Well, it all depends on what you have to pay for electricity. In certain localities you would get it for much less than in others.

The CHAIRMAN. Yes.

Mr. BINDING. For charging batteries you usually use commercial power, and it is converted into direct current into the battery. It can vary all over, depending on what your rates are. It could be determined actually in kilowatts used or, for instance, we take a battery that we use up, say, 300-ampere hours. It means we have to put back into that battery the same amount of current, and that is a matter of varied opinion as to just what it costs to charge a battery. You really can't say.

The CHAIRMAN. Any further statement that you have?

Mr. BINDING. No, I think that covers my story.

The CHAIRMAN. Do you gentlemen wish to ask any questions? We know we are going to have a rollcall vote the moment that they get a quorum over there.

Mr. BINDING. Sure.

The CHAIRMAN. Any questions?

Senator SPARKMAN. No questions here.

The CHAIRMAN. Senator Smathers?

Senator SMATHERS. Have you made a testimonial for this? Have you signed a statement?

Mr. BINDING. I have never signed any statement. I mean, anything I have said has been verbal because I am in a—I hope you will appreciate that I am in sort of a particular spot on this thing. We manufacture and buy good quantities of batteries, both the lead kind and other types, and it puts me in sort of a difficult situation, depending on how the results of this whole thing finally turns out. I am not under duress, I am not being intimidated or anything of that sort. I simply have nothing to gain; I have nothing to lose.

The CHAIRMAN. You are not a relative of Mr. Ritchie?

Mr. BINDING. No, sir.

The CHAIRMAN. You are not on a commission basis?

Mr. BINDING. No, sir.

The CHAIRMAN. What does the battery salesman say about the reaction of this battery that you were informed was no good and should be junked? What does the battery salesman say?

Mr. BINDING. They say they can't understand it. They have to admit that it is a remarkable thing; that is from a fellow who has been in the battery business a good many years—he can't understand it. It is a phenomenon that he says he is not in condition to pass any judg-

ment other than that, apparently, in this particular case it has measured up to all expectations.

The CHAIRMAN. For the benefit of all of you gentlemen I have never seen the gentleman before, and I do not think our paths have crossed anywhere in our lives.

Mr. BINDING. I don't think so.

Senator SMATHERS. Let me ask you this question: Did Mr. Goodwin treat any of the batteries but the first one?

Mr. BINDING. That is all. After that I got onto the technique and all the other batteries I treated personally; I didn't take any chances.

Senator SMATHERS. In treating them, you followed what amounted to the servicing part of it, the cleaning of the poles and——

Mr. BINDING. Actually, I didn't clean the poles. I had maintenance men clean the top off, so that you didn't get electrical——

Senator SMATHERS. During your experience with batteries, have you ever tried the solution of sodium sulfate and magnesium sulfate on batteries?

Mr. BINDING. I had never—this is my only experience in dealing with any additives, and it is my only knowledge. Although, naturally, reading scientific papers in years gone by, every once in a while there would be something supposedly sensational printed, but I had no particular reason to get interested in it at the time.

Senator SMATHERS. No further questions, Mr. Chairman.

The CHAIRMAN. I have no further questions.

I am going to ask, what we should do about the quorum call. It is possible that they will agree on a voice vote after they get a quorum. Should we take the next witness? We have three more whom we had scheduled to hear this afternoon.

Senator SMATHERS. Whatever suits the chairman.

The CHAIRMAN. Thank you, Mr. Binding.

The next person, then, if he will come forward, will be Mr. William Pursell of the Walter Baker Chocolate Co., Boston, Mass.

Will you take your place at the table? Would you raise your right hand and take the oath? Do you swear that the testimony you are about to give pertaining to the matter now before this committee is the truth, the whole truth, and nothing but the truth, so help you God?

Mr. PURSELL. I do.

TESTIMONY OF WILLIAM PURSELL, PLANT ENGINEER, WALTER BAKER CHOCOLATE AND COCOA DIVISION, GENERAL FOODS, DORCHESTER, MASS.

The CHAIRMAN. You may proceed, sir, in any manner you wish.

Will you state for the record who you are? And I will ask you the question, are you any relation of Mr. Ritchie?

Mr. PURSELL. No, sir.

The CHAIRMAN. Have you any interest in Mr. Ritchie's business?

Mr. PURSELL. None whatever.

The CHAIRMAN. And you have no commission from the sale of the product or anything like that?

Mr. PURSELL. No, sir.

The CHAIRMAN. Fine, sir. You may proceed.

Mr. PURSELL. My name is William Pursell. I am the plant engineer for the Walter Baker Chocolate and Cocoa Division of General Foods at Dorchester, Mass.

As plant engineer, I am charged with the responsibility for the maintenance and installation of equipment and machinery, the buildings and the grounds.

We have 13 large lead storage batteries of an industrial type which are used in the operation of forklift trucks. Most of those batteries have a replacement value today of about $1,700.

We identify our batteries as A, B, C, and D, and on down the alphabet, so that we can keep a daily record of them.

In February 1947 battery B was delivered to us. It was immediately placed in a fork truck and would not operate for a full 8-hour period. Now, with each of our fork trucks, we have 2 batteries, 1 of which is being used and the other on charge or waiting to go to work.

We immediately called the representatives, the service engineers of the company. They came and inspected the battery. Of course, we put it on charge. The charge was given, as much as the battery would take. The engineer said, "That is perfectly all right." We put the battery to work again, and it again failed to do a normal 8-hour trick, or 8-hour shift.

That procedure continued for a considerable period of time. The warehouse foreman was reluctant, however, to use the battery any more than was just absolutely necessary, because of breaking into his loading schedule during the regular shift. After 5 years, we had decided that we would sell the battery for junk on the recommendation of 1 of the battery service engineers, and buy a new battery.

The CHAIRMAN. How much would you get for the junk?

Mr. PURSELL. We were offered $105 for the old battery.

Now, in April of 1952, we treated the battery with AD–X2. It was on the 14th. The next morning the battery was placed into service after having been put on charge during the night. That battery was treated by Mr. Goodwin, who I suppose used the technique as printed on the envelope. We had nothing to do with how he put the powder into the electrolyte.

The next morning the battery was placed in the fork truck and operated the fork truck a full 8-hour shift for the first time in the 5 years that we had it. It has been doing that consistently from that time until Tuesday morning, when I left to come down.

Based on the experience of battery B we thought that we would like to salvage another battery which was not doing very well for us, and this is battery D. In the middle of January 1952 battery D, along with 2 other old batteries, was sent to the battery manufacturer's repair shop, with instructions to repair battery D by removing the best cells from the other 2 batteries and placing them in battery D.

The battery came back to us on February 19, 1952. We ran the battery from February 1952 until the 19th of November in 1952 without being treated. In other words, the battery came to us in 1946. It was rebuilt in January and early February 1952; so it was approaching 6 years of age. And it was treated in the middle of November 1952.

The battery consistently did a good day's work until June the 2d of this year, and the battery then failed and has been removed from service.

We feel that we obtained our money's worth on the second battery. We just barely got our money back. On the first battery, it has long since paid for the treatment.

With that experience, on January 30, 1953, when we bought our last fork truck battery, which cost us in the neighborhood of $900, it being a little smaller than the other two that I have referred to, we bought it new and treated it in a new condition. We treated it before it went into service.

The CHAIRMAN. What did it cost you to treat that battery?

Mr. PURSELL. I am sorry, I don't remember that. It cost $180 to treat the first 2, $180 each, for the battery which costs about $1,700 now, as a replacement. Our thinking at the time we agreed to treat the battery was this: The treatment would cost $180. It cost us, or it cost us at that time, about $25 a month to own the batteries, because we expect and do get 60 months of service from those large batteries, 5 years. So by dividing the 60 months into the cost of the battery, which was then at that time about $1,500, it amounted to $25 a month.

If we could extend the life of the battery for 7 months, we had $175 of our $180 back. So we thought we would gamble with that, and since that time, of course, the first one has run 14 months. So we are well repaid for the $180 that we put in.

On the second one that failed this past June because of mechanical difficulties, we just barely got our money back.

The CHAIRMAN. How much did it cost you to overhaul that battery at the time that you sent the batteries back to the factory and they took the best segments out of the 2 and put them into the 1 battery, so that you made 1 serviceable battery?

Mr. PURSELL. I don't know that.

The CHAIRMAN. You do not recall that?

Mr. PURSELL. I do not recall the figure on that. But I would be able and willing to get that information for the committee if it is of interest.

Then we have 60 glass-cell storage batteries which are of a stationary type. They are used in conjunction with our watchman's alarm system, and also with the tripping mechanism on the circuit-breakers in our powerhouse. Sixty of those cells were treated in March of this year with AD–X2. At that same time, we had 20 cells that are in the sprinkler system, and the same type of batteries, treated with AD–X2.

That is the extent of our work with AD–X2.

We feel that the battery treated in January, which was new—the results of that we probably will not know for 5 years, because normally the battery would last us that long. The glass-cell batteries were in good condition, being less than 2 years of age when they were treated, and those batteries last for many years. We have been able, and found it advisable, to reduce the current charge to the batteries since we have treated them.

The CHAIRMAN. What is the approximate cost of those glass-cell batteries? Are they expensive?

Mr. PURSELL. As I remember, it was $77 for each cell.

The CHAIRMAN. $77 for each cell?

Mr. PURSELL. For each cell; yes.

Senator SPARKMAN. For each cell?

The CHAIRMAN. Yes; and there were 60 cells in 1 group and 20 cells in another.

Mr. PURSELL. Yes, sir; a total of 80.

The CHAIRMAN. A total of 80 cells?

Mr. PURSELL. Yes, sir. I am taking that figure from memory. If it is incorrect, when I write to you concerning the cost of repairing the battery, I will then have that figure.

The CHAIRMAN. Are there any questions?

Senator SMATHERS. Yes, sir. I would like to ask: Are you familiar with the fact that in this treatment there are two separate parts of it, as I understand it? First is the servicing part, or servicing system, and then the AD–X2 system. In other words, the powder goes along with it. But he also has, as I understand it, a servicing business.

Now, with that in mind, do you know how many packages of this $3 per package AD–X2 he put into this first big battery, battery D?

Mr. PURSELL. No, sir; I do not.

Senator SMATHERS. Would you think that he put as much as 60 packages into it?

Mr. PURSELL. Yes; I would think that he did.

Senator SMATHERS. In other words, you would treat that 1 battery by putting 60 packages of that AD–X2 into it?

Mr. PURSELL. I am not sure of that number. It could easily have been that many, because they apparently measure the size of the cell and get its cubic content, and then immediately determine how many packages it takes. And I saw a considerable number of these small envelopes lying around at the time, and my recollection is that there would have been 60 of them.

Senator SMATHERS. In each little package, I understand, there are two envelopes full of AD–X2. There may be more. We have one there.

The CHAIRMAN. There are three. Any normal automobile battery has three compartments, and you put a package in each compartment.

Senator SMATHERS. I just wondered if this big battery that you are talking about would be large enough to take something like 60 packages, which would be 180 little paper envelopes for that battery.

Mr. PURSELL. No. When you were speaking of packages, I thought that you were speaking of the individual envelopes, the little white paper envelopes.

Senator SMATHERS. No. I was speaking of this red package right here. I saw one here a minute ago. Anyway, it is about the size of—well, you have seen them.

Mr. PURSELL. Yes. I would think, Senator, that 60 of the packages are probably more than they may have used.

Senator SMATHERS. So it would appear that this charge of $180 to give the treatment to this battery D, that much of that cost to you, in addition, was represented in some service other than just powder, the AD–X2.

Mr. PURSELL. We suspected so, because Mr. Goodwin came and examined the height of the water and fixed the battery up in good style before he left.

The CHAIRMAN. What do you mean by "fixed it"?

Mr. PURSELL. He saw that the chemical, or the AD–X2, was adequately dissolved, and that the correct amount of water was on top of the plate.

The CHAIRMAN. Did he take the battery down or anything like that?

Mr. PURSELL. He did it right in our plant.

The CHAIRMAN. You mean, he did not take the battery down to his shop or anything?

Mr. PURSELL. No, sir.

The CHAIRMAN. These batteries are huge batteries, as I understand it?

Mr. PURSELL. Yes, sir.

The CHAIRMAN. How heavy are they?

Mr. PURSELL. They weigh better than 2,000 pounds. They weigh better than a ton.

The CHAIRMAN. In other words, they are just mammoth things?

Mr. PURSELL. Yes, sir.

The CHAIRMAN. So that no man is going to push them around or pull out any cell unless he has cranes to do it with?

Mr. PURSELL. No. We did no prior preparation of this thing other than clean off the top and treat it.

The CHAIRMAN. So it was just a question of pouring the powder into the cells?

Mr. PURSELL. That is right.

The CHAIRMAN. No other service was done?

Mr. PURSELL. No.

The CHAIRMAN. Now, have they come and rendered any service on these glass cells?

Mr. PURSELL. They treated the glass cells.

The CHAIRMAN. Did they do any mechanical work on them?

Mr. PURSELL. None whatsoever.

The CHAIRMAN. All in the world they did was take the caps off and pour the powder in and see that there was sufficient water to cover the plates?

Mr. PURSELL. They have, as I remember, a rubber syringe which they work with their hands to suck the electrolyte up and down and gradually dissolve powder as it goes into the cell.

The CHAIRMAN. So there was no mechanical work?

Mr. PURSELL. None whatsoever, on any of our batteries.

The CHAIRMAN. Do you think that you would discontinue the use of this compound if you were able to continue purchasing it?

Mr. PURSELL. No, sir.

The CHAIRMAN. You would buy it if you were able to buy it, so that you would make an application in every new battery you put in service?

Mr. PURSELL. We have done that, sir, on the last new battery that we bought. I would not want to say that we would do it for every new battery that we get in the future, because we would like to go cautiously enough to see what battery B will eventually do. Battery B is the one which has been going for the past 14 months very well, and if it should go, let us say, maybe 6 months or another year longer, it would give us more confidence to go ahead with the treatment of our new batteries. I do not see any new battery which will be necessary in the next 6 months. So, consequently, we feel we have that much time to see what battery B will do.

The CHAIRMAN. But, without the additive, you know that you would have bought some batteries in the past 6 months?

Mr. PURSELL. We know that we would have spent $1,500 14 months ago to replace battery B.

The CHAIRMAN. If you had not put the powder in?

Mr. PURSELL. If we had not treated it; that is right.

The CHAIRMAN. Now, battery B did not have any mechanical repair or any mechanical service?

Mr. PURSELL. None whatsoever.

The CHAIRMAN. Except the application of the powder?

Mr. PURSELL. Yes, sir.

The CHAIRMAN. Are there any further questions?

Senator SMATHERS. On battery B, at the time that you got the treatment, what was the shape of battery B, again?

Mr. PURSELL. Battery B just would not take a charge; neither would it hold a charge. But mechanically it was in sound condition, one of the reasons for that being that it would not do a full day's work; it had never done a full day's work. So the warehouse foreman would not use it any more than just necessary. So consequently it sat quietly for a large portion of that 5 years.

The CHAIRMAN. And after the application, it came up and performed in a normal manner?

Mr. PURSELL. Yes, sir. It has for the last 14 months.

The CHAIRMAN. And it is still performing?

Mr. PURSELL. It was still performing when I left on Tuesday morning.

The CHAIRMAN. Are there any further questions?

Senator SMATHERS. That is all.

The CHAIRMAN. Thank you.

The next person is Mr. Howard Spaulding of the Gillette Safety Razor Co.

Mr. Spaulding, will you raise your right hand?

Do you swear that the testimony you are about to give pertaining to the matter now before this committee is the truth, the whole truth, and nothing but the truth, so help you God?

Mr. SPAULDING. I do.

TESTIMONY OF HOWARD P. SPAULDING, CHIEF ELECTRICAL ENGINEER, GILLETTE SAFETY RAZOR CO., BOSTON, MASS.

The CHAIRMAN. You may proceed, Mr. Spaulding, in just any manner that you wish. But I would like to have you state for the record your responsibilities and what your duties are in connection with the Gillette Safety Razor Co.

First, are you any relative of Mr. Ritchie?

Mr. SPAULDING. No, sir; I am not.

The CHAIRMAN. Are you an acquainance of any long term with Mr. Ritchie?

Mr. SPAULDING. No. I never met Mr. Ritchie until I came here to Washington yesterday.

The CHAIRMAN. On this trip?

Mr. SPAULDING. Yes, sir.

The CHAIRMAN. And you do not receive a commission or anything in the handling of the product?

Mr. SPAULDING. None whatever, sir.

The CHAIRMAN. Therefore, you are unbiased?

Mr. SPAULDING. And a free agent.

The CHAIRMAN. Thank you, sir. You may proceed.

Mr. SPAULDING. Regarding my position with Gillette, on the management organization chart, I am the chief electrical engineer. My duties concern taking care of the more intricate electrical problems of all the Gillette properties in this hemisphere, that is, Montreal, Boston, Mexico City, Rio de Janeiro, and Buenos Aires.

I would like to say that our experience with Gillette, or what we are doing there, is actually conducting an uncontrolled and unscientific experiment to determine what AD–X2 may do in the way of prolonging the life of our batteries.

The CHAIRMAN. How did you happen to become acquainted with it?

Mr. SPAULDING. My first acquaintance, our first knowledge of AD–X2 came about, I would judge, 3 or 4 years ago. I am not certain whether it was 3 or 4 years ago. The supervisor in charge of electricians came to me with a little clipping that he had cut from a trade journal stating that the better business bureaus had indicated that AD–X2 was not a suitable product for use.

The CHAIRMAN. Were you using any of it at that time?

Mr. SPAULDING. No, sir. I had never heard of it until that time.

The CHAIRMAN. Was it that ad that aroused your curiosity?

Mr. SPAULDING. It did, in a sense.

The CHAIRMAN. It did?

Mr. SPAULDING. Yes, sir.

The CHAIRMAN. And then you wanted to satisfy your curiosity?

Mr. SPAULDING. Not at that time. I felt that its condemnation by better business bureaus should be a sufficient indication that I should not spend the company's money on the product, and I did not give it further consideration.

The next time I heard of AD–X2, I did something which troubled my conscience considerably. The receptionist called and told me there was a salesman downstairs representing AD–X2, and I told her I was very busy, which was the truth, and wondered if she could arrange to have the supervisor of electricians interview him. And when I say it troubled my conscience, I feel this way regarding salesmen coming to the door.

I have a job because salesmen, many salesmen are abroad selling the product which we manufacture, and I like to feel that our salesmen are well received. I, therefore, make it a point always to see a salesman. And if I cannot see him, if I am busy, I talk to him on the phone and tell him I am sorry and would like to have him call me later to make a definite appointment. And it troubled my conscience somewhat to have brushed this man off, because, although I was busy, I could have seen him in a half hour, or something like that.

So I was kind of looking forward to rectifying what I considered an injustice.

The next time I heard of AD–X2 was in May, I believe, or it may have been April.

The CHAIRMAN. Of what year?

Mr. SPAULDING. Of 1952. The receptionist called and said there was a man by the name of Mr. Goodwin at the door to see me regard-

ing AD–X2, and I said, "Send him up." I felt I had a chance to rectify my previous injustice, or at least hear his story.

At that time, he told me of Mr. Pursell's experience, which has just been related, with a battery that had not performed too well, and he told it to me in such a convincing manner that I felt that in his enthusiasm he was very truthful. In fact, when he invited me to call Mr. Pursell on the phone and ask him about it, I felt that he certainly was telling me the truth. I decided then that it would be well to try some of the AD–X2 to form my own conclusions.

I arranged for Mr. Goodwin to send to our purchasing department a quotation which would show the cost for treating three different sets of stationary batteries which we have in the plant.

The CHAIRMAN. How expensive are those stationary batteries?

Mr. SPAULDING. Those stationary batteries—I have photostatic copies of the purchase price. Could I define them first as, one group we call the clock batteries. Those batteries control our impulse clocks throughout the plant, and also in-and-out timecard records throughout the plant. Those batteries, which we had in service at the time Mr. Goodwin called, I cannot give you a price on because we obtained them from the telephone company when they discarded them from our own switchboard as unfit for further use by them.

The CHAIRMAN. The telephone company had discarded them as not fit?

Mr. SPAULDING. That is right.

The CHAIRMAN. Because they cannot fail on the switchboards?

Mr. SPAULDING. That is right.

The CHAIRMAN. Or rather, they must not fail on the switchboard. That would be better phraseology.

Mr. SPAULDING. Yes, sir.

At the time the telephone company was installing a new switchboard to take care of our growing requirements, and I had seen these batteries which were being removed, I was not aware that they were going to dispose of them, because they looked pretty good to me. And the telephone company keeps their equipment in very good condition. I believe a man calls at the plant either once a week or once every 2 weeks to check the condition of all the equipment, including the batteries, and they are given very good care and kept very clean. They are in glass jars, and their mechanical condition can be readily observed.

So the price of those batteries is an indeterminate factor, as far as I am concerned. In the meantime, when I got word they were going to dispose of them, I found that the telephone company had arranged to give them to their scrap dealer with whom they usually did business. So we had to make a little transaction with the scrap dealer and give him a little money, although he never touched them, and it was a very little sum. I don't know just what it was.

The CHAIRMAN. This was in May 1952?

Mr. SPAULDING. Yes, sir. Let me see. No. I am a little wrong on that. That telephone battery was acquired in February of 1952. It was May or April when I first met Mr. Goodwin.

The CHAIRMAN. I beg your pardon. That is correct.

Mr. SPAULDING. Yes, sir. Those telephone batteries were obtained on January 24, 1952. They were then 6 years old, according to what the telephone men told me.

Now, to go on with the cost, I understood from the telephone men that those batteries were worth about $40 apiece. They were a special and well-constructed battery.

The CHAIRMAN. But they were then 6 years old?

Mr. SPAULDING. Yes, sir. Now, as for the cost of the other batteries, a second battery I will refer to, we know as the fire alarm, watchman system, door alarm, and sprinkler waterflow alarm battery. That battery was installed new in January 1951 and the purchase cost was $756.

The third battery we know as the circuit-breaker control, emergency lighting and generator excitation battery. That was purchased and installed at the same time, January 1951, and it cost $744.

That, I think, covers your question regarding costs, does it?

The CHAIRMAN. That is right. I want the costs on account of replacement expense.

Mr. SPAULDING. Yes, sir.

Now, if I may be permitted, I have a few notes on each of the three batteries.

The CHAIRMAN. You are permitted, sir. It is up to you.

Mr. SPAULDING. Thank you.

First, the clock battery. We have two banks of clock batteries. Each bank contains 18 cells, glass-jar cells, and they are in groups of 3 cells per battery, or 6 batteries making up the 18 cells. The batteries were placed in service February 1952, at which time they were charged to only 36 volts. That was not satisfactory for our service, because we were operating a 32-volt system, and the batteries which we discarded were delivering from 28 to 30 volts, varying with the state of the charge, and as they are pretty important to us we called in the battery representative, and he advised that we should have new ones. We did not buy the new ones.

The CHAIRMAN. You treated them?

Mr. SPAULDING. That is correct, sir.

The CHAIRMAN. And when did you treat them?

Mr. SPAULDING. We treated them on May 5, 1952.

The CHAIRMAN. And they had been recommended to be discarded?

Mr. SPAULDING. Yes, sir; by the battery manufacturer's agent.

The CHAIRMAN. By the manufacturer's agent, who informed you that the batteries should be discarded, and this was May 5, 1952?

Mr. SPAULDING. It was previous to that that he had made the recommendation.

The CHAIRMAN. That is a vote. Now we go, and we will cast the vote, and we will come right back.

(There was a short recess.)

The CHAIRMAN. If we may come back to order, I believe that the other members of the committee will be back very soon. But in order that we may complete the hearing of those who were scheduled for this afternoon, with the uncertainty of what may happen over in the Senate Chamber, I believe that we had better resume.

So you may proceed, Mr. Spaulding.

Mr. SPAULDING. Thank you, sir.

The CHAIRMAN. If you want to know just where you left off, the reporter will read back the last remark, please, if you would like to know.

Mr. SPAULDING. I would, please.

The CHAIRMAN. All right. The reporter will read back just where you are.

(Whereupon the reporter read back the last question and answer.)

Mr. SPAULDING. These clock batteries were treated with AD–X2, May 5, 1952, and within a week the voltage, which previously had registered 36 as the maximum, then registered 40 volts, showing an increase of 4 volts on the charge, or about what they should normally be.

The CHAIRMAN. From 36 to 40?

Mr. SPAULDING. Yes, sir.

The CHAIRMAN. Or a 4-volt increase?

Mr. SPAULDING. Yes, sir. The 40 is about normal.

Now, these particular batteries, on the side of each case, have 3 little balls, and when the battery is fully charged, all of the 3 little balls are at the top, and as the battery discharges, the little balls fall down one at a time. In other words, the first ball will fall when the battery is 30 percent discharged.

The CHAIRMAN. These are glass cases?

Mr. SPAULDING. Yes, sir.

The CHAIRMAN. So that you can look right into the case any time?

Mr. SPAULDING. Yes, sir.

The CHAIRMAN. And these little balls that are resting in there are for the convenience of the supervising engineer? He can always see just where that battery charge is inside that battery?

Mr. SPAULDING. Yes, sir.

The CHAIRMAN. It is a speedy, rapid reading? You do not have to go around there with an instrument?

Mr. SPAULDING. That is right, sir. So with that indication, we could easily discern when the batteries were 30 percent discharged, because the first colored ball, which I believe is green, falls upon 30 percent discharge. And before treatment at the point of 30 percent discharge, 12 hours at an initial charging rate of 1.5 amperes was required to charge to 36 volts. After treatment, at 40 percent discharge, only 3 hours were required to charge to 40 volts at the same initial rate of 1.5 amperes.

The CHAIRMAN. Do you have any figures on what the cost is of regenerating those batteries?

Mr. SPAULDING. I do not, sir. I have no concise figures. We generate much of our own power, and we buy some, and the actual cost would be very hard to ascertain. We have no metering equipment on such a small installation.

The CHAIRMAN. You just pull off your regular installation wiring?

Mr. SPAULDING. Yes, sir.

Another observation made on these batteries was that before treatment, the electrolyte was cloudy, and as near as could be judged, there was about an eighth of an inch of sediment on the bottom of each jar. And after treatment with AD–X2, much to my surprise, the electrolyte became very clear, and the sediment, also to my surprise, was practically nonexistent.

The CHAIRMAN. You mean, it dissolved the sediment in the bottom of this glass jar, so that you could easily see it dissolved?

Mr. SPAULDING. Yes, sir.

The CHAIRMAN. And it seemed to dissolve that sediment?

Mr. SPAULDING. Yes, sir. There is just a gray film on the bottom of those jars at the present time. And that sediment has apparently gone back into the plates as active material.

The CHAIRMAN. Those sediments would be what, in the bottom of the jar, if they were permitted to accumulate? Would that be particles of lead that were flaked off the cells of the battery?

Mr. SPAULDING. Yes, sir; the products of sulfation.

The CHAIRMAN. And each time that that lead flaked off, it lowered the capacity of the battery?

Mr. SPAULDING. Yes, sir.

The CHAIRMAN. So that when that was dissolved, and it was permitted to become part of the liquid, it just went back and worked through the battery compartments, or cells?

Mr. SPAULDING. Apparently that is what happened; yes, sir.

Now, I have these observations on our fire alarm, watchman system, door alarm, and sprinkler waterflow alarm battery.

Senator FERGUSON. Would you speak just a little louder?

Mr. SPAULDING. Yes, sir. That battery consists of 2 banks of 24 cells each. Each cell is in a glass-jar container, so that the mechanical condition can readily be observed. This battery was installed new in January 1951, and treated May 5, 1952.

Senator FERGUSON. What did it cost?

Mr. SPAULDING. The treatment, sir?

Senator FERGUSON. No; the battery.

Mr. SPAULDING. The battery cost $756.

This particular battery is equipped with a low-voltage alarm set at 48 volts, because if the voltage, through discharge of the battery, should fall below 48 volts, our fire-alarm system would not turn in an accurate indication, and if that alarm should sound, an attendant throws the battery in service onto charge, and the reserve battery into service.

Now, I have only a few observations on that battery, and they are this: That before treatment with AD–X2, at which time the batteries were about 16 months old, it required 6 hours at 4.5 amps of initial current to charge the battery to 50 volts, which seemed normal for the battery. It certainly was a satisfactory voltage for our purpose. After treatment with AD–X2, the charge at the same current required only 3 hours, and the batteries charged to 52 volts as against 50 volts before treatment.

The final observation is that before treatment the electrolyte was cloudy and there was slight sediment in the bottom. The batteries were in very good condition. But that sediment disappeared after treatment with AD–X2.

Senator FERGUSON. What is your conclusion?

Mr. SPAULDING. On this particular battery, sir?

Senator FERGUSON. Yes. Do you think that this product did any good?

Mr. SPAULDING. Well, it obviously must be doing something that is good, because we have voltage higher than we originally had before treatment, and we have no trace of sediment, and sediment is a detriment to a battery.

Senator FERGUSON. Are you an engineer?

Mr. SPAULDING. Yes, sir. I am a registered professional engineer in the Commonwealth of Massachusetts.

Senator FERGUSON. Have you ever known that things would react in certain ways, that scientists could not figure out just why they reacted?

Mr. SPAULDING. By hearsay, but I have no exact knowledge. I have heard the bumblebee story, and a few things like that.

Senator FERGUSON. A scientist put in the record yesterday under oath that that was not a true story that a scientist said a bumblebee could not fly. So that has been exploded, as far as I am concerned. But what I have in mind is that there are experts here who have tested this thing from a scientific point, who say that it will not work and cannot work.

Mr. SPAULDING. I realize that, sir.

Senator FERGUSON. Now, you come in and say you saw it work?

Mr. SPAULDING. Yes, sir. And when I heard the testimony yesterday, I was inclined to doubt my eyesight, but the facts are there, and the batteries are in the plant to be viewed by anyone.

The CHAIRMAN. There must be some advantage, if it requires 3 less hours to recharge those batteries, and they must be recharged how often? Daily?

Mr. SPAULDING. No; as required. These batteries receive erratic service.

The CHAIRMAN. Then are they charged once a month, or more often than that?

Mr. SPAULDING. It would be difficult to say just how often they are recharged. They are given an inspection every morning by an electrical man rated as a grade B electrician, and if he should notice that the voltage on the voltmeter indicated it was getting down toward 48 volts, he would throw the switches over to charge the battery in service and place a reserve battery in service before the alarm went off. I cannot say how frequently that is done, but it is my recollection that it is about every 2 or 3 months.

The CHAIRMAN. The only way that you could be accurate is to put a meter on that individual line and then take a meter reading over a period of, say, months, in order to find out just what voltage was necessary for the recharge, and then you would have whatever the cost of the current is that you are using?

Mr. SPAULDING. Yes, sir.

Senator FERGUSON. If the Post Office Department had brought you in as a witness, would you have told them that, in your opinion, this was a fraud, and the mails should not be used to sell this product?

Mr. SPAULDING. I would have told them that, from what I have seen today, I would have no reason to feel that a fraud had been committed. However, I believe, Senator, before you came in, I pointed out that we are conducting an uncontrolled and unscientific experiment——

Senator FERGUSON. I understand. But you saw this, and you say that it works?

Mr. SPAULDING. Yes, sir.

Senator FERGUSON. And you are willing to spend your company's money to buy it, to put it in batteries?

Mr. SPAULDING. Yes, sir. When it came to spending the company's money, I felt this way: The quotation for servicing all of our batteries amounted to $480, and I am constantly seeking ways to save money.

Senator FERGUSON. Do you think this is saving you money?

Mr. SPAULDING. At the moment, the indications are that we will save money. Before I can feel entirely conclusive in the matter, I will have to wait a few more years. In the case of our clock battery, which was discarded by the telephone company, I shall have to wait approximately another 5 years to feel that the life of the battery has been doubled by the addition of AD–X2.

Senator FERGUSON. Has any time been added, in your opinion? Has any life been added, in your opinion?

Mr. SPAULDING. I feel that there has, because our experience with the very best type of battery we could buy has been that they have lasted not over 6 years.

Senator FERGUSON. And how old is this one now?

Mr. SPAULDING. This battery we acquired from the telephone company, I am told by them, was 6 years old in January 1952.

The CHAIRMAN. Senator Ferguson, you were not here when Mr. Spaulding first made explanation of these batteries that they acquired second-hand. They were discarded by the telephone company, batteries used on the telephone company's switchboard, and, of course, a battery on a switchboard must not fail; and, therefore, the telephone company had replaced them before they were dead batteries. And the Gillette Safety Razor Co. bought them from a junk dealer that had acquired them as junk from the telephone company, and they serviced them with AD–X2 compound, and then put them in service, and that was in the year of 1952 that you put that on your line?

Mr. SPAULDING. We put that battery on our line in February 1952. It was May 5, 1952, when we had them serviced with AD–X2.

The CHAIRMAN. When you had them serviced with AD–X2. And since you serviced them with AD–X2, they are performing as a new battery?

Mr. SPAULDING. Yes, sir. They are at maximum voltage. They are now 7 years and 4 months old, and in my experience I have not seen such batteries last over 6 years.

The CHAIRMAN. So that at the present time, they are better than a year over any life expectancy that you have seen on this type of battery?

Mr. SPAULDING. Yes, sir.

The CHAIRMAN. Now, you have one other series of batteries that you have not touched on, and that was your third series that you gave us information on.

Mr. SPAULDING. Yes, sir. The third battery is known as the circuit breaker, emergency lighting, and generator-excitation control battery. That battery consists of 60 cells, each cell being in a glass-jar container. That battery was installed new in January 1952, and treated May 5, 1952. Now, in the case of this battery, it is on what we call a floating charge. The charger is connected to the battery at all times. The battery is also connected to outgoing lines which may serve electric lights, the circuit breakers, or the excitation of the generator whenever required.

And we feel that it is less expensive to keep the battery on a floating charge than to buy a second standby battery. And because of that, we cannot evaluate the effects of treatment with AD–X2 in terms of response to charge.

That is, we do not know whether that battery is taking the charge better since treatment than it did before, or not. We have no way of determining that.

So the only observation I can make on that battery is this: That before treatment the full voltage was 130, which is certainly sufficient for our needs. However, after treatment that voltage rose to 132, which is significant, but I would not buy AD–X2 for the purpose of getting that 2 extra volts. I would like to make that clear.

The CHAIRMAN. What have you noticed about sediment in that set of batteries?

Mr. SPAULDING. The same condition occurred as in other batteries. Before treatment, the electrolyte was cloudy and there was slight sediment in the bottom, nothing of a serious nature at all. But the cloudy electrolyte is now crystal-clear, and the sediment has disappeared entirely.

There is just a trace of gray film on the bottom of the glass jar of each cell.

The CHAIRMAN. Mr. Spaulding, from your own personal experience in your own business, would you have thought this committee irresponsible to the businessmen that we are endeavoring to assist, if we had ignored the problem of the businessmen like yourself who are now using this product and the manufacturer of this product, and if we had not proceeded with the hearing? There is this fraud order that was suspended, but the effect of it is still there, in that it was only suspended for a time.

Would you have thought us negligent as a small-business committee if we had not endeavored to go into this question, to try to get all the facts into a record?

Mr. SPAULDING. Yes, sir; I would have thought so.

The CHAIRMAN. I was somewhat questioning my own judgment when I felt it was absolutely necessary, and a responsibility that this committee go into it. And with as tight a schedule as we have, I was reluctant to do it. But I have looked over this material, and my judgment was that the committee had a responsibility, and we went into it.

Are you satisfied that the committee should go into it and get all the facts into the record, and then examine all the facts from the record?

Mr. SPAULDING. Yes, sir; I am satisfied that that should be done.

The CHAIRMAN. And you are satisfied to the extent that you have used the product, that it is beneficial to you and to your company, not only financially, but through the apparent prolonging of the life of these storage batteries?

Mr. SPAULDING. Yes, sir. I believe I mentioned before that to have a concise and factual conclusion in my own mind, I would like to see what the results will be 5 years hence.

The CHAIRMAN. Now then, Mr. Spaulding, would it make any difference to you whether this was epsom salt, or any other kind of salt, if it performs for you?

Mr. SPAULDING. No, sir; it would not. It could be anything at all as long as it did the job.

The CHAIRMAN. It could be just plain rainwater, provided it did the job that it is doing for you?

Mr. SPAULDING. Yes, sir; or, as I mentioned to someone else, it could be foot powder, or flea powder; if it did the job, I would buy it.

Senator FERGUSON. Could it be possible that you are imagining that this clears the sediment out of the clouded electrolyte?

Mr. SPAULDING. Sir, I must confess, in listening to testimony yesterday, I almost doubted what I felt in my own mind. But the evidence is there, and I am quite sure of it.

Senator FERGUSON. You are sure that you are right?

Mr. SPAULDING. Yes, sir.

Senator FERGUSON. You saw it?

Mr. SPAULDING. Yes, sir.

The CHAIRMAN. In the event that you are being fooled, how would your associate executives of the company feel toward you, if you were being fooled?

Mr. SPAULDING. I think, sir, that they would feel that I was one of the few who could perhaps be fooled all the time, and they had better investigate me further.

Senator FERGUSON. You do not think that this powder is hypnotic?

Mr. SPAULDING. No, sir; I do not believe that it could have that effect.

Senator FERGUSON. You know, the thing is, the way the evidence appears here, the consumers, the users, say one thing about this, and the scientists say the other thing.

Mr. SPAULDING. Yes.

Senator FERGUSON. Some of the scientists. And I wondered whether or not you were seeing things, or seeing the results.

Mr. SPAULDING. I would like to say in passing that yesterday, in listening to testimony, I almost questioned my own reasoning, because from early youth, I would possibly say in high school, the physics teacher probably first acquainted us with the Bureau of Standards, and we heard that everything that is good in the way of development of various equipment is all based on standards set up by the Bureau of Standards; and the point I am trying to make is that all through my life I have had the greatest respect for that organization, and the feeling that the man at the head of it must be terrifically well-qualified to handle such a job.

With that in mind, as I say, I almost questioned my own observations.

Senator FERGUSON. Has the Gillette Co. any connection with this Ritchie Co., or the Pioneers Co.?

Mr. SPAULDING. None that I know of, sir.

Senator FERGUSON. No financial connection?

Mr. SPAULDING. No, sir.

Senator FERGUSON. How long have you known Ritchie?

Mr. SPAULDING. I met Mr. Ritchie for the first time yesterday.

Senator FERGUSON. So he is just a casual acquaintance as of yesterday?

Mr. SPAULDING. Yes, sir.

Senator FERGUSON. Could you tell the committee how you got here? I mean, did they subpena you, or what?

Mr. SPAULDING. No, sir. It was requested by the chairman that I come, and I have the letter here saying that it would be greatly appreciated.

Senator FERGUSON. In other words, the committee had learned that you were a user, and asked you to come in?

Mr. SPAULDING. Yes, sir. I believe that a Mr. Amis of the committee staff called upon the local representative around the Boston area and asked for the names of some users.

Senator FERGUSON. And Mr. Amis was furnished your name as a user?

Mr. SPAULDING. Yes, sir. He came to the plant and interviewed me, and I gave him certain information at that time.

The CHAIRMAN. The reason Mr. Amis did that was that when this question came before the committee earlier this year, and we were endeavoring to get all the facts together, I instructed the staff to get all the information possible from the users of the product, as well as all the information from the MIT laboratory and the Bureau of Standards' laboratory, and anything that they could find anywhere, because I felt that we had a responsibility to try to find the answers to the many questions that were apparently in the minds of so many people about what this was all about. That is why Mr. Amis was making contacts, in order to get the history of your experience in your plant, and in other plants.

Mr. SPAULDING. Yes, sir.

The CHAIRMAN. Have you anything further, Mr. Spaulding, that you want to say?

Mr. SPAULDING. I believe not, sir. This pretty well covers the only observations that I am able to make at this time.

The CHAIRMAN. In the event that you put new batteries into service and you could buy the AD–X2 compound and put it into the batteries, would you do that?

Mr. SPAULDING. I think, sir, at this moment, under the conditions, I would want to wait for the results of the finding of your committee.

The CHAIRMAN. That is, of the Small Business Committee?

Mr. SPAULDING. Yes, sir; for this reason: This has now come to the attention of our top management. Prior to the visit of Mr. Amis, neither my boss, nor anyone else, except the electrician and the purchasing agent, knew that we had any AD–X2 in the plant. Now, when any of us leave town, our president is informed because he may want to give us some information if we are going to another plant or to a sales office. So they are aware of why I am here. And although I am convinced in my own mind that if I owned the plant and it were my own money, I would treat every battery that came in with AD–X2, I am perhaps influenced somewhat by the fact that they, the top management, might question my spending that money until the findings of this committee have been made known.

The CHAIRMAN. You see, Mr. Spaulding, the fact is one of big concern in my mind, because if that is your decision, that may be the decision of many other administrative executives, and the business is suffering from it, and there is just a certain amount that any business firm can suffer in the loss of sales until their doors are closed.

And that is the big concern. I fear that the final test that now will be conducted by the new committee of scientists created for the purpose of making a study may have to run into many months. If I were a member of that committee, I would have to erase every shadow of doubt or question before I would pass an opinion that reflected one

way or another on the Bureau of Standards, and naturally they would. It may run 18 months or 2 years before the final field test will be published, and, therefore, the manufacturer of AD–X2 and his associates can well be out of business. And that is why I maintain, as chairman of this committee, that a determination on that suspended fraud order in the Post Office Department must be made.

I want to thank you for the information you have given us, Mr. Spaulding, if that concludes your remarks.

Mr. SPAULDING. Yes, sir.

The CHAIRMAN. Then, we will proceed to bring Mr. Parkhurst of the United-Carr Fastener Co., Cambridge, Mass., to the stand.

Mr. Parkhurst, do you swear that the testimony you are about to give pertaining to the matter now before this committee is the truth, the whole truth, and nothing but the truth, so help you God?

Mr. PARKHURST. I do.

TESTIMONY OF E. TYLER PARKHURST, ELECTRICAL ENGINEER, UNITED-CARR FASTENER CORP., CAMBRIDGE, MASS.

The CHAIRMAN. You may proceed. I wish you would tell, for the sake of the record, what your position is with the United-Carr Fastener Co., and also whether you are a relative of Mr. Ritchie.

Mr. PARKHURST. I am not.

The CHAIRMAN. Are you a long acquaintance of Mr. Ritchie or his family?

Mr. PARKHURST. No, sir. I met Mr. Ritchie yesterday morning for the first time.

The CHAIRMAN. And you have no interest in the AD–X2 product or the manufacturing firm that makes the product?

Mr. PARKHURST. None whatever.

The CHAIRMAN. You may proceed.

Mr. PARKHURST. My name is E. Tyler Parkhurst. I live at 64 Parker Street, Newton Centre, Mass. I am an electrical engineer in the employ of the Carr Fastener Co. Division of the United-Carr Fastener Corp., 31 Ames Street, Cambridge, Mass., for whom I have worked since February 1950.

Mr. Amis and Mr. Forsythe, staff members of your committee, have questioned me at Carr Fastener Co. concerning the use by us of battery compound AD–X2, manufactured by Pioneers, Inc., Oakland, Calif., and supplied to us by Guaranteed Batteries, Inc., 108 Brighton Avenue, Allston, Mass. They have requested that I attend this hearing to testify concerning our experience with AD–X2.

We have 26 battery-operated electric trucks for materials handling. Three are forklift trucks, powered by 16-cell electric storage batteries. The other 23 are smaller trucks, powered by 6-cell batteries. These trucks are used 10 to 12 hours each day of the workweek, between 7 a. m. and 7 p. m., and their batteries are recharged 5 to 6 hours each night. Supervision of the maintenance of this equipment in proper operating condition is one of my responsibilities.

Approximately twice a year, a representative of the Electric Storage Battery Co. checks all our electric truck storage batteries for us. In early March 1952 a check was made by their Mr. Wynott. He reported all the batteries in good condition except one 16-cell battery

which had been purchased by us in January 1948 for $1,060.15 and utilized regularly from the time of delivery. The manufacturer of that battery had estimated its life expectancy as 52 months, 50 of which had passed. It was used in 1 of our 3 forklift trucks, the largest electric trucks we operate.

He stated that this battery had 3 partially shorted cells and, in his opinion, could not be expected to give more than 3 months' further service. Instead of functioning properly for the full 10 or 12 hours of expected operation each day, this battery had been running down at about 4 p. m., so that the truck it powered had to be taken out of operation pending recharge of the battery. The scrap value of that battery was $113.94.

Senator FERGUSON. When did that happen?

Mr. PARKHURST. I am sorry, Senator?

The CHAIRMAN. The date? When did they claim that the battery was no longer serviceable and offer you $113 as the junk price?

Mr. PARKHURST. In March of 1952.

The CHAIRMAN. March 1952.

Mr. PARKHURST. On March 14, 1952, we ordered a replacement 16-cell battery at a cost of $1,363.02. This battery was delivered on April 18, 1952, and was held in reserve, as a spare, against the time that the weak battery would give out entirely.

Our purchasing department was familiar with the circumstances surrounding our purchase of the new battery. With this in mind, when Mr. Norman Goodwin, of Guaranteed Batteries, Inc., called at our purchasing office on April 30, 1952, he was referred to me.

Mr. Goodwin described the product AD–X2 as a battery additive intended to prolong the lives of electric storage batteries. He stated that his company would guarantee for 1 year the satisfactory operation of any battery his company treated with AD–X2. On inquiry from me, he quoted a price of $160 for the treatment with AD–X2 of the 16-cell battery for which we had bought the replacement. I knew that the life expectancy of the replacement battery, as indicated by its manufacturer, was 6 years. The replacement battery cost $1,363.02, or $227.17 per year of its expected 6-year life. I, therefore, reasoned that, with the year's guarantee, we could not lose if we had the battery for which the replacement had been bought treated with AD–X2 at a cost of $160. Consequently, I had the defective battery treated by Mr. Goodwin on the day of my talk with him, April 30, 1952.

At the time of the treatment, he first tested the battery by use of hydrometer and voltmeter to ascertain, according to him, whether the battery was in condition to accept AD–X2 treatment. On finding that it was, he poured AD–X2 powder from sealed paper bags into the various cells of the battery. He drew some battery solution up into his hydrometer and poured it back into the cells on top of the AD–X2. That completed the treatment. The battery was being charged during the treatment, and Mr. Goodwin directed that it should remain on charge for 1 hour afterward. The treatment took place in the afternoon. I cannot recall whether the battery and truck went back into service that day or whether they remained out of service until the battery was charged that night before going back into service the next day.

On the next day, the battery functioned satisfactorily all day and has been in constant service 10 to 12 hours per day since that time with no sign of failure.

The CHAIRMAN. Now, before that time, would that battery perform all day long?

Mr. PARKHURST. No, sir; it would not.

The CHAIRMAN. When did it reach a point where it would have to be pulled out of service because the battery was too weak to lift its load?

Mr. PARKHURST. It would average 4 o'clock in the afternoon, Senator.

The CHAIRMAN. And now it was ready to render service for 8 to 12 hours a day?

Mr. PARKHURST. That is right, sir.

The invoice dated May 1, 1952, we received from Guaranteed Batteries, Inc., which paid for the AD–X2 treatment of the battery was for $160 and contained the statement, "Guaranteed for 1 year."

On the strength of this experience and to continue our experiment in the use of AD–X2, I had a smaller battery (6 cells, 12 volts) which powers a smaller truck treated in June 1952 when it failed partially. Mr. Goodwin had said AD–X2 would prolong the expected lives of sound batteries. In June 1952 I also had a sound 6-cell battery treated. In September 1952 I had another sound 6-cell battery treated. The charge for the treatment of each of these smaller batteries was $36. This type of battery costs $364 new. It has an expected life of 6 years; so its cost per year is $60.67. Its scrap value is $18.

By February 1953 I felt that our good experience with the AD–X2 treatment of the large battery to dissolve the sulfation which had impaired its function indicated merit in the AD–X2 claims that treatment of sound batteries would prevent sulfation.

Sound batteries treated with AD–X2 had shown no adverse effects. Thus, I believed we were justified in having all our untreated batteries treated in a long-range experiment to determine the effect of AD–X2 toward prolonging the lives of sound batteries. In February, March, and April 1953 I had all of the untreated batteries, including a new spare 16-cell battery bought in February 1953, treated. None of these batteries has been treated a second time. As I understand it, AD–X2 is not recommended for use in more than a single treatment of a battery.

At the present time all 27 of our electric truck batteries contain AD–X2. All have functioned satisfactorily from their treatment up to the present.

That is all.

The CHAIRMAN. Do you think it should be the business of this committee to make certain that there is nothing that would hinder the sale of this product and that there should be no action of the Government denying you the right to purchase this product?

Mr. PARKHURST. From the experience that my company and I have had with it, I sincerely feel that way.

The CHAIRMAN. You feel that it would be an injustice if the Government denied you the right to purchase the product?

Mr. PARKHURST. Yes, sir.

The CHAIRMAN. And a fraud order would be the same as denying the manufacturer the right of using the mails that would make possible the selling of his product?

Mr. PARKHURST. Yes, sir.

The CHAIRMAN. You are a businessman, and cold, factual figures mean everything to you. Do the figures here prove conclusively that it is money saved for your company to use the product?

Mr. PARKHURST. I feel very definitely that that is true.

The CHAIRMAN. It would not make any difference to you whether it was epsom salts or foot powder, as the other gentleman said, just so long as you got results from it?

Mr. PARKHURST. It could be salt and pepper, Senator. I am interested in results and not in what goes to make up the material.

The CHAIRMAN. Thank you.

Mr. PARKHURST. There is just one thing, Senator, that I did not include in this, because I did not think it was necessary. But in the light of statements made yesterday regarding the ability to fool some of us all the time and all of us some of the time, I think it would be well to put in the record that I am a graduate electrical engineer of Massachusetts Institute of Technology.

The CHAIRMAN. So that you have the training and the ability because of your experience to evaluate what you see and what you read and what you do?

Mr. PARKHURST. I hope so.

The CHAIRMAN. And the results you obtain?

Mr. PARKHURST. I hope so.

The CHAIRMAN. Thank you, sir.

We will resume our hearings in room 318 tomorrow morning at 10 o'clock.

(Whereupon, at 5:10 p. m., a recess was taken until 10 a. m. Friday, June 26, 1953.)

BATTERY AD-X2

FRIDAY, JUNE 26, 1953

UNITED STATES SENATE,
SELECT COMMITTEE ON SMALL BUSINESS,
Washington, D. C.

The committee met, pursuant to recess, at 10 a. m., in room 318, Senate Office Building, Senator Edward J. Thye (chairman) presiding.

Present: Senators Thye (chairman), Hendrickson, and Gillette.

Also present: Robert A. Forsythe, chief counsel; Blake O'Connor, professional staff member; and William D. Amis, investigator.

The CHAIRMAN. If the assembly will please come to order, the committee will resume its hearings.

The first witness this morning is Mr. Piantadosi. Will you come forward and take the chair there at the table.

Will you please raise your right hand? Do you swear that the testimony you are about to give pertaining to this matter now before this committee is the truth, the whole truth, and nothing but the truth, so help you God?

Mr. PIANTADOSI. I do.

TESTIMONY OF CHARLES C. PIANTADOSI, FOREMAN OF TRANSPORTATION, NAVAL AIR STATION, QUONSET POINT, R. I.

The CHAIRMAN. You may proceed.

Would you state for the record, please, your full name, where you are employed, and what your responsibilities and duties are, and the amount of equipment that comes under your supervision or responsibilities, in order that the committee and the general public may have the information?

Mr. PIANTADOSI. My name is Charles C. Piantadosi.

In order to identify myself, Mr. Chairman, I would like, with your permission, to read a few notes.

The CHAIRMAN. You may proceed in any manner that you desire, sir, because I want you to be perfectly at ease. We are seeking information. We are not endeavoring to cross-examine or persecute.

Mr. PIANTADOSI. I am a full-time member of the Society of Automotive Engineers. I am on the executive committee of the National Master Mechanics and Foremen Association of Naval Shore Establishments of the United States. At the present time I am foreman of transportation at the Naval Air Station at Quonset Point, R. I., in charge of maintenance, repair, and operation of approximately 1,100 automotive and construction materials and handling equipment. They range in sizes from scooters to locomotives.

I have established a permanent program of work improvements and an excellent program of beneficial suggestions in order to promote efficiency in our organization, and in so doing, we are attempting to get dollar for dollar in value from the taxpayers' money that we are spending.

The CHAIRMAN. That is very laudable.

Mr. PIANTADOSI. Now, in order to carry out this program of maximum efficiency, we must, therefore, experiment on ideas and suggestions submitted to us by our employees and others to explore the possibilities of effecting savings in our operations and in carrying on our daily tasks and missions assigned to us.

All of this, however, will take many types of field experiments and will also take many hours, days, and months until proper evaluation can be made of the materials or equipment or whatever it may be that we are experimenting on.

Now, sir, first of all, I want to say on this AD–X2, the first I heard about it was sometime in April 1952.

The CHAIRMAN. How did you hear about it at that time?

Mr. PIANTADOSI. I was off the station one day, and the next morning when I came back, the transportation officer, who was a lieutenant at the time, told me that a Mr. Goodwin had come down here from the Guaranteed Batteries, that is, at Quonset, and he had something that was outstanding, and it was marvelous and would probably help us in the troubles we were having with our batteries. I told the transportation officer at the time, I said, "Well, I've seen a lot of this stuff," not AD–X2, but other materials, and although our TPTR–2, which is a manual made up by the Navy guiding our——

The CHAIRMAN. How long had you been there with the Naval Air Station?

Mr. PIANTADOSI. Since July 1940.

The CHAIRMAN. July of 1940?

Mr. PIANTADOSI. That is right.

The CHAIRMAN. And you had been working with batteries?

Mr. PIANTADOSI. No, sir. I was charged with buildings and grounds for part of the time, and in the past 5 years, I have had charge of the equipment and the transportation operation.

The CHAIRMAN. That includes all the trucks and automobiles and anything that is a vehicle?

Mr. PIANTADOSI. That is right. I will go back a little further. I am not a battery expert. I have been in the construction and automotive field all my life, for the past 30 or 32 years, and have been a contractor, a construction contractor, until 1935, and, of course, sometime in 1936 I went to work for the Government, when it became necessary, when a lot of us went out of business. But I have always been in and around automotive and construction equipment all these years. I do know what trouble it is when it gets zero or close to zero, in starting equipment which is kept outside, and almost all our equipment is outside. You know, the Navy doesn't have garages. We are lucky to have garage space to repair them, and many times we have to repair vehicles outside because of lack of space. You people here limit our appropriations, and then we have to make the best of it.

The CHAIRMAN. Just in order that you can appreciate what Senator Gillette and the other members of this committee have to face—

Senator Gillette is here with us now—we have the trouble, as we are the buffer between what you need and what the taxpayer thinks about it.

Mr. PIANTADOSI. That is right.

The transportation officer, a Lieutenant Vivoli, had informed me that Mr. Goodwin was coming back in a few days, I got a call from the pass office that Mr. Goodwin was there and he wanted to see us, and we admitted him. You see, Mr. Chairman, with all these salesmen who come in and want to visit us in our department, we make it a policy that they are taxpayers, and we want to extend them the most extremely courteous means that we have, so that you people will not be bothered here. Therefore, he happened to be one of the men that we welcomed.

The CHAIRMAN. I have never met Mr. Goodwin.

Mr. PIANTADOSI. You will probably see him sometime today.

The CHAIRMAN. We hope to.

Mr. PIANTADOSI. Mr. Goodwin said he had AD–X2 in his automobile battery. Not being a battery expert myself, I followed my quarterman in charge of all repairs, and his assistant, Mr. Goodwin, and the transportation officer, to see this demonstration that he was going to put on. So he put the lights on and his radio and all kinds of electrical gadgets on it, and then he put his finger on the button and his foot on the starter, and churned the battery right down dead. Then he let it rest a while, 5 or 10 minutes, and started all over again, and then it lasted a few more minutes, and it went on, all together, 3 times. I don't remember whether it was 8 or 10 minutes.

The CHAIRMAN. He was trying to exhaust the battery?

Mr. PIANTADOSI. That is right. But each time when it ran down, he would wait a few minutes and start all over again, and she would still have a little more to turn over.

The CHAIRMAN. Now, had he put the compound in the battery?

Mr. PIANTADOSI. He said he had put the compound in.

The CHAIRMAN. He had put the compound in?

Mr. PIANTADOSI. I don't know. He said he did.

The CHAIRMAN. He said he did?

Mr. PIANTADOSI. That is right.

The CHAIRMAN. And had your quarterman been here at the time?

Mr. PIANTADOSI. This is Mr. Goodwin's battery in his own personal car.

The CHAIRMAN. I beg your pardon. That is his own personal battery?

Mr. PIANTADOSI. I don't come from Missouri, but I wanted to be shown, you see. And he was demonstrating before we spent the money.

The CHAIRMAN. I see.

Mr. PIANTADOSI. But this went on, and quite a good sales talk along with it. So we decided we would buy 24 packages, because, with all this equipment we have in the naval air station, 80 percent of it is being driven by military personnel, young fellows who leave home and go in the Navy, and they do the best they can, but in most cases, sometimes, they are not good enough on good equipment.

In cold weather, we keep it outside, and they choke up the engine, and the first thing you know, it won't start, and they will churn it

right over until the battery goes dead. So I figured if we try a few packs of this in some of these vehicles, when the battery goes down, we could send a qualified man afterward, and it might have enough life, if this was so, to start it up without necessitating the change of a battery.

So when we purchased 24 packets of this material, Mr. Goodwin came down and put it in our batteries, with my supervisor, his assistant, and the battery man.

The CHAIRMAN. Did he take the batteries out of the vehicle at the time he put it in?

Mr. PIANTADOSI. This is at the time we purchased it, when he put this material in our vehicles.

The CHAIRMAN. In the vehicle shop?

Mr. PIANTADOSI. In the battery shop. No, Senator, we didn't have to take the batteries out of the vehicles.

The CHAIRMAN. There was no mechanical service done to the battery at the time? All he did was to put the powder in?

Mr. PIANTADOSI. Yes.

The CHAIRMAN. He did not remove or do any mechanical work on the battery?

Mr. PIANTADOSI. No, he did not. But I want to make one thing clear, that the batteries that we put this material in were mechanically sound or new batteries.

The CHAIRMAN. They were new batteries?

Mr. PIANTADOSI. Absolutely.

The CHAIRMAN. But they were in the vehicle at the time?

Mr. PIANTADOSI. That is right, sir.

The CHAIRMAN. And the man did not do any service work or any repair or make any examination? The batteries were new batteries in vehicles?

Mr. PIANTADOSI. That is right, sir.

We had had trouble with vehicles with two-way radios, fire equipment, because the radios are being used considerably, particularly in some of this crash equipment, and we were changing batteries regularly. For instance, this vehicle, vehicle No. USN 18664, a Plymouth coupe pickup, equipped with a two-way radio—this is, of course, Navy equipment, and I am talking now—I have a free hand—they told me to come down here and tell nothing but the truth, with no strings attached. So I am free to answer any questions.

In the Navy, for all of our equipment, we have a vehicle jacket, in other words, just like you would a personnel jacket in a personnel office. And when any work is performed on any vehicle that we have, it is so marked on a job-repair card, and it is then brought into the office, transcribed on a master card, and the work-repair card is put in the jacket for a period of 1 year, and then we remove them, and we have a transcription in brief of the work involved on a master card, which always stays with the vehicle. When the vehicle is transferred to another station or another activity, the vehicle jacket accompanies the vehicle. So, therefore, the man who receives this vehicle will have a history of it, whether the engine has been fixed or whatever work has been performed on it from time to time.

I think it is an excellent system that we have in the Navy—I don't know about the other armed services—which gives us a clear picture of the condition of the vehicle at all times.

On this particular vehicle that I mentioned, on November 28, 1949, we changed the battery, and November 30, 1949, we changed the battery again, and on August 23, 1951, we changed the battery again. On March 10, 1952, we changed the battery again, and on May 7, 1952, approximate date, we added AD–X2 into this vehicle.

The CHAIRMAN. That was in 1952?

Mr. PIANTADOSI. Yes, sir. We put a new battery in the vehicle.

The CHAIRMAN. And that was in May of 1952?

Mr. PIANTADOSI. In May of 1952, we added AD–X2. This is approximately the 6th or the 7th, offhand. Up to this date, we haven't changed or charged the battery since then.

The CHAIRMAN. Do you mind going over that again and giving us the figures, because you were reading them so rapidly, and I did not know just what you were leading up to, and I did not keep track of all those dates.

Mr. PIANTADOSI. All right, sir. On November 28, 1949, there was a battery change; November 30, 1949, we changed the battery again. That went along to August 23, 1951; we changed the battery. We then put this piece of equipment in the fire service for the fire chief, with a two-way radio.

The CHAIRMAN. Yes.

Mr. PIANTADOSI. Then we changed the battery on March 10, 1952. Then on May 7, 1952, we added AD–X2, and to this date we haven't changed the battery or charged it in that particular vehicle.

The CHAIRMAN. Is that vehicle in use in just the same manner that it had been in all the previous years?

Mr. PIANTADOSI. Yes, sir.

The CHAIRMAN. And the reason why you had battery trouble was the excessive load because of the two-way radio system?

Mr. PIANTADOSI. This particular vehicle, prior to August 23, 1951, was not in the fire line, in the fire equipment line.

Senator GILLETTE. Did I understand you to say that on November 28, 1949, you put in a battery, and then on November 30, 1949, you changed it?

Mr. PIANTADOSI. That is right. Apparently somebody——

The CHAIRMAN. Two days after?

Mr. PIANTADOSI. Two days after; that is right, sir. You see, when we change a battery, what I mean by that is that we take a battery out of a vehicle and put it on the line of charge and put another battery in, just as you would in your car when you go to a gas station, you see.

Senator GILLETTE. I see.

Mr. PIANTADOSI. It is not because the battery is no good any more.

The CHAIRMAN. But you had to charge the battery?

Mr. PIANTADOSI. That is right.

The CHAIRMAN. Because it would not hold its load?

Mr. PIANTADOSI. That is right, sir.

The CHAIRMAN. I mean, it would not take care of the load that it was compelled to carry.

Mr. PIANTADOSI. That is right.

Now, we have vehicle No. U. S. Navy 287231. That is a Chevrolet pickup. And that is equipped with a two-way radio. And here are the battery changes. I will read them. Starting at August 31, 1950, the battery was changed. It was changed again November 8, 1950. The

battery was changed again March 7, 1951. It was changed May 14, 1951; on June 15, 1951; on July 16, 1951; on August 13, 1951; on August 20, 1951; on September 6, 1951; on September 11, 1951; on September 13, 1951; on October 31, 1951; on January 7, 1952; February 12, 1952; February 14, 1952; March 4, 1952. And then on approximately May 6, 1952, we put a good battery, mechanically sound, a practically new battery, in the car, and added AD–X2, and up to June 19, this battery is still in the vehicle, without any charge of any kind.

The CHAIRMAN. You mean that with the AD–X2 added——

Mr. PIANTADOSI. That is right, sir.

The CHAIRMAN. And that was on May 6, 1952?

Mr. PIANTADOSI. Approximate date; yes, sir.

The CHAIRMAN. And the vehicle was in use in exactly the same manner that it had been in use in the previous year?

Mr. PIANTADOSI. Yes, sir.

The CHAIRMAN. And do you recall how old the automobile was in 1950? Was that a new automobile?

Mr. PIANTADOSI. The 287 series—this looks like a 1949 vehicle to me.

The CHAIRMAN. 1949? And it went through 1950 and 1951, and you made all of these changes of batteries because the battery had to be pulled out for the purpose of recharging?

Mr. PIANTADOSI. That is right, sir.

The CHAIRMAN. The generator on the automobile engine was not sufficient to keep the battery up so that it could carry the load of the two-way radio?

Mr. PIANTADOSI. That is right, sir.

The CHAIRMAN. And then, on May 6, 1952, you put a brand-new battery in?

Mr. PIANTADOSI. That is right, sir.

The CHAIRMAN. And you added AD–X2?

Mr. PIANTADOSI. Yes, sir.

The CHAIRMAN. And from there on the generator on the automobile engine gave it sufficient generation, and the battery has carried the load of that vehicle from May 6, 1952, and that is better now than a year?

Mr. PIANTADOSI. That is right, sir. I do not know what it is or what is in there.

Senator GILLETTE. Mr. Chairman, may I ask a queston there?

The CHAIRMAN. Certainly.

Senator GILLETTE. During those changes in 1951 and the early part of 1952 that were so numerous, do you say that you just took out the battery and recharged it and replaced it?

Mr. PIANTADOSI. Yes, sir. But, you see, we have so many vehicles—we may possibly have 2,000 batteries of 6 volts, 12 volts, 8 volts, and so on. Say, for instance, on a 6-volt battery, we have various kinds of batteries, 1's, 2's, and 3's. Now, we might have 8 or 10 1's and 8 or 10 2's in a battery shop. When a car comes in, this one has possibly a No. 2 battery in it, and we just take that one out and put another one right in again, fully charged.

Senator GILLETTE. You would not say it was the same battery?

Mr. PIANTADOSI. Oh, no.

Senator GILLETTE. But it was a used battery?

Mr. PIANTADOSI. Used and new, too, Senator.

Senator GILLETTE. What is that?

Mr. PIANTADOSI. It could be a new battery that would be on the line as well.

Senator GILLETTE. It might have been a new battery?

Mr. PIANTADOSI. Yes. Probably on a series of these changes there could have been 2 or 3 new batteries put in there.

Senator GILLETTE. But the battery that you put in when you used AD–X2 was a new battery?

Mr. PIANTADOSI. Absolutely, because the carton, or the little package, says that you should put it in a new battery or a battery in good mechanical condition. And when I am trying something out I want to make sure that I am following instructions, and then we would have a comeback with these people.

Senator GILLETTE. And it has had practically the same use, or comparable use?

Mr. PIANTADOSI. That is right, sir.

Senator GILLETTE. And it has gone now 14 months, or practically 14 months?

Mr. PIANTADOSI. It has.

Senator GILLETTE. And it is still in use?

Mr. PIANTADOSI. Yes, sir. You see, Senator, my job is, we will say, 60 percent administrative, or more, and 35 or 40 percent in the field, in the shops and the field. So these records that I have here are taken from the mechanics who have changed the battery or performed work on this vehicle.

So to the best of my knowledge, these are records from our files.

Senator GILLETTE. To all intents and purposes, these that you call jackets are service records of the machines?

Mr. PIANTADOSI. Absolutely.

Senator GILLETTE. Similar to the service records of the serviceman?

Mr. PIANTADOSI. Yes.

Senator GILLETTE. And they go along with the machine?

Mr. PIANTADOSI. That is right, sir.

Senator GILLETTE. That is all, Mr. Chairman.

The CHAIRMAN. Thank you.

Mr. PIANTADOSI. Then here we have another vehicle which is USN 287243. It is another Chevrolet pick-up with a two-way radio, and we changed the battery on May 17, 1950; on June 2, 1950; on September 13, 1950; on November 28, 1950; December 5, 1950; on June 22, 1951, we installed a new battery in there. On September 21, 1951, we changed the battery. On January 9, 1952 we did some work. We put a charger plug that they wanted in order that the battery would charge up. It didn't work out so well. So on May 10, 1952, we added AD–X2.

The CHAIRMAN. Do you know now whether that was a new battery?

Mr. PIANTADOSI. Yes, sir.

The CHAIRMAN. That was a new battery?

Mr. PIANTADOSI. That was a new battery.

The CHAIRMAN. And these other changes up here, there was a possibility of a new battery, or were they all used batteries?

Mr. PIANTADOSI. New batteries and used batteries, Senator. We have so many on the line, you see.

The CHAIRMAN. Yes.

Mr. PIANTADOSI. We have a high point and a low point in the Navy, so that we won't waste any money. In other words, the highest

that we can have on a certain type is set up, say, at 10 batteries, and the low limit, 3. So when they get down to a low limit, we make sure that they are replenished.

The CHAIRMAN. In other words, if you get down to where you have only three batteries that have just been charged up ready for replacement, you requisition for new batteries in order that you may always have some on the line ready to replace a dead battery?

Mr. PIANTADOSI. That is right, sir. But the figure would not be three. For instance, if we had 200 batteries of the same type, I would have probably a high limit of 10 and a low limit of 3. But if we only had 5 vehicles, I would probably have a high of 2 and a low of 1. It all depends. We couldn't spend the money and just have them lying around.

The CHAIRMAN. Then in order that we make certain that we are making a fair comparison, did you find that a brand-new battery that you would put in an automobile fully charged under that load, would go down and have to be taken out of the vehicle for purposes of recharging?

Mr. PIANTADOSI. Yes, because in batteries and automotive equipment, there is a human element involved. Everybody does not drive a vehicle the same way.

The CHAIRMAN. The reason for the question was primarily in order to make certain that we by no chance would be getting this sort of comparison here, that by accident they happened to be all older batteries or used batteries that had been put in this vehicle over a period of this number of changes in the 2 years' time. And that was the reason for the question, was there a new battery, to your knowledge or from your record, that happened to go into that vehicle in the period that you were making these changes through 1950 and 1951?

Mr. PIANTADOSI. Yes.

The CHAIRMAN. Then we would be certain that if a brand new battery went in and did not hold up, then it was the load factor. But if they were all older batteries, then it might be the weakness of the battery that was the factor, you see.

Mr. PIANTADOSI. Senator, the fact that a battery is brand new or 6 months old doesn't make any difference. A 6-month-old battery should perform as good as 95 percent efficient, at least.

The CHAIRMAN. If it is mechanically sound, it should.

Mr. PIANTADOSI. That is right; I mean, under normal conditions, and so forth.

The CHAIRMAN. Yes, because a battery 6 months old should not be sulfated, and if they have been kept with water in them, that battery should be mechanically sound.

Mr. PIANTADOSI. It should.

The CHAIRMAN. All right. I am sorry for the interruption. You were down to 1952.

Mr. PIANTADOSI. May 11, 1952.

The CHAIRMAN. May 10, 1952.

Mr. PIANTADOSI. Pardon me; May 10, 1952.

The CHAIRMAN. Yes, sir.

Mr. PIANTADOSI. We added AD–X2, and on July 17, 1952, it showed on the record that there was a battery change in that vehicle. Now, whether they put the same battery back on again, I could not tell you, one with AD–X2 in it. Then again on February 2, 1953, there was

another change in battery, and in that there was battery additive put in, and from February 2, 1953, to date, no trouble has been had from that battery.

The CHAIRMAN. You have not had any trouble from that battery?

Mr. PIANTADOSI. No, sir.

The CHAIRMAN. Now, you put one in on January 2, 1953?

Mr. PIANTADOSI. February 2, sir.

The CHAIRMAN. February 2. I beg your pardon. That is correct. On February 2, you put a new battery in, and you added AD–X2 in that battery, and you have not had any trouble. Now, that, of course, is just 5 months.

Mr. PIANTADOSI. That is right.

The CHAIRMAN. Well, not 5 months, but about 4 or some.

Mr. PIANTADOSI. About 4 months.

The CHAIRMAN. Four months.

Mr. PIANTADOSI. Now, we have a diesel 44-ton locomotive, and that takes a heavy-duty diesel battery, 8-volt batteries. We went back to November 7, 1949, on our records, and we changed three of the batteries then. On November 23, 1949, we changed all the batteries.

The CHAIRMAN. On November 23, 1949, you changed all the batteries?

Mr. PIANTADOSI. Yes, sir. And on January 10, 1950, we changed six batteries. On March 20, 1950, we changed batteries; August 1, 1950, we changed batteries. You see, we use 12-volt batteries in there and cut off part of the cells in order to make our 6 volts in 8-volt cases. That is why you see 6 volts in 8-volt cases.

Now, on September 6, 1950, we changed batteries again, all of them. On January 3, 1951, we installed a new set of batteries and cables. On December 3, 1951, we put in all new batteries again, because we put our 8-volt batteries back, and the original eight had gone down, and had to be charged, and we had to replace others from the spares. And on April 28, 1952, we reissued the old batteries again. In other words, we changed batteries again. And then on October 30, 1952, we checked the batteries and added AD–X2.

The CHAIRMAN. Now, were these new batteries or used batteries?

Mr. PIANTADOSI. These are the batteries that we had installed on April 28, 1952.

The CHAIRMAN. They were installed, you said——

Mr. PIANTADOSI. That is right, sir.

The CHAIRMAN. In 1952?

Mr. PIANTADOSI. That is right, sir.

The CHAIRMAN. And they were new batteries?

Mr. PIANTADOSI. They were new batteries.

The CHAIRMAN. How much did those batteries cost?

Mr. PIANTADOSI. I would venture that those batteries run around $96 or $98 apiece.

The CHAIRMAN. Around $96 or $98. And you use how many batteries?

Mr. PIANTADOSI. Eight.

The CHAIRMAN. You use eight batteries. It requires eight batteries in use for your locomotive?

Mr. PIANTADOSI. That is right, sir. It requires 64 volts in other words.

The CHAIRMAN. And they cost around $96?

Mr. PIANTADOSI. Approximately. I don't have the exact figures.

The CHAIRMAN. Then on October 30, 1952, you installed these batteries, and you added AD–X2?

Mr. PIANTADOSI. No, sir. We installed the batteries on April 28, 1952. And on October 30, 1952, we checked the batteries and added AD–X2.

The CHAIRMAN. So they were not new batteries when you added the AD–X2?

Mr. PIANTADOSI. No, sir. They are mechanically sound. They were new just a few months previously, you see.

The CHAIRMAN. On April 28, they were new batteries?

Mr. PIANTADOSI. That is right.

The CHAIRMAN. And under normal conditions, how long does one of these batteries last?

Mr. PIANTADOSI. Those batteries should give us at least 2½ to 3 years.

The CHAIRMAN. Yes; 2½ to 3 years. So then in October is when you added the AD–X2?

Mr. PIANTADOSI. That is right, sir. Now, we haven't had any battery trouble to this date.

The CHAIRMAN. Will you have to pull those batteries out to recharge?

Mr. PIANTADOSI. No, sir. They have been recharging themselves.

The CHAIRMAN. In other words, you have a generator on the locomotive?

Mr. PIANTADOSI. That is right, sir.

The CHAIRMAN. And that generator has been carrying the load of replenishing the battery, so that you did not have to pull the batteries out to recharge?

Mr. PIANTADOSI. That is right, sir.

The CHAIRMAN. How heavy are these batteries, approximately?

Mr. PIANTADOSI. Offhand I don't know. They are close to 80 to 100 pounds.

The CHAIRMAN. How many hours of manual labor are required to change a set of batteries in that?

Mr. PIANTADOSI. I would say it would take an average of 2½ hours to make a change, 2 men's time, in other words.

The CHAIRMAN. Is it 2 men's time for 2½ hours, or a total of 5 hours to change the batteries whenever you make these changes?

Mr. PIANTADOSI. Let me say this, Senator. To change the batteries—in other words, to take a set of batteries out of the locomotive, when the man leaves the shop, he goes out to wherever the locomotive is, 2, 3, or 4 miles away, and takes the batteries out, and puts the other batteries in, and brings the other batteries to the shop and puts them on the line. All that is man-hours.

The CHAIRMAN. Yes, sir. That is what I was getting at.

Mr. PIANTADOSI. Not only the time involved in a changing of the batteries, but also the time of getting there, getting back and pulling them off, and——

The CHAIRMAN. But what I was trying to get clear in my mind was the amount of man-hours needed whenever you had a battery failure. And when you have a battery failure, that locomotive is dead.

Mr. PIANTADOSI. That is right.

The CHAIRMAN. And, therefore, you would have to send men out to pull the batteries out and install new batteries, and you think that 5 man-hours is required when you are compelled to make a change of the batteries?

Mr. PIANTADOSI. That is for the complete change; 4 to 5 man-hours.

The CHAIRMAN. And prior to the adding of AD–X2, what did you anticipate would be the number of months before you would have to pull a set of batteries to have them recharged because the generator on the locomotive was not sufficient to carry a full load in the batteries? Roughly, just say how often you think in a year's time you would have to pull those batteries in order to have them recharged.

Mr. PIANTADOSI. Here in 1951, 1952, and 1953, we charged them 4 times. But, Senator, there is more to this than these records show, too. On cold mornings, this locomotive is either inside or outside. If there is room in one of the big warehouses, we pull it in. If not, it is outside. Many, many times we don't change these batteries, but we use a booster battery to start them. We have, in other words, a series of batteries on a truck with cables long enough to start the engine. In other words, we help it along with the boosters.

The CHAIRMAN. Yes; because if those big diesel motors are cold, it takes something to turn them over.

Mr. PIANTADOSI. That is right. Now, this past winter we haven't had to do that.

The CHAIRMAN. You mean, since you added the AD–X2?

Mr. PIANTADOSI. That is right, sir.

The CHAIRMAN. Your batteries have had sufficient power within themselves——

Mr. PIANTADOSI. That is right, sir.

The CHAIRMAN. So that you did not have to use a set of booster batteries on the first start in the morning when the motors are stiff?

Mr. PIANTADOSI. That is right, sir. That is what our records indicate.

The CHAIRMAN. And that has gone on now since October 28; so you have had an entire winter's experience?

Mr. PIANTADOSI. That has gone on since October 30, 1952; that is right.

The CHAIRMAN. October of 1952?

Mr. PIANTADOSI. 1952.

The CHAIRMAN. And you have gone through the entire winter of 1952–53?

Mr. PIANTADOSI. That is right, sir.

The CHAIRMAN. And you have started when the motors were stiff in the morning without the aid of a booster battery?

Mr. PIANTADOSI. That is right, up to this day, that is, up to the day I left.

The CHAIRMAN. How long would it take for a man to get a set of booster batteries around to hook up to get that initial start in the morning?

Mr. PIANTADOSI. I would say 15 minutes, ten or 15 minutes; that is all.

The CHAIRMAN. But it would require a man's time to get those other batteries around there to hook up?

Mr. PIANTADOSI. Not only the men's time, Senator; but the four men on the railroad crew would have to wait until we could get there, because in the wintertime our vehicles all being outside, we have a lot of vehicles to start, and I have some men come early in the morning and go home early in the day after their 8 hours are up so that we won't tie up production, and we go on line of priority. It all depends. Maybe some have to wait before we get there. So there is a loss there.

The CHAIRMAN. And these locomotives are used for what purpose?

Mr. PIANTADOSI. To switch our freight cars around on incoming and outgoing freight, and also——

The CHAIRMAN. So it is not just the fact that the locomotive is waiting at that time, but it is men waiting for the cars in the warehouse to be loaded and unloaded? You might have a number of men down the line waiting for that car to be switched?

Mr. PIANTADOSI. That is right. You see, we have to go up to Davisville every morning, which is approximately 3 miles, onto the New Haven main line to get our cars. They just push them in the gate and leave them there, then we have to sort them out and classify them.

The CHAIRMAN. This is what we would normally term a switch engine in the yards for the purpose of spotting the cars that came in there either for loading out or unloading?

Mr. PIANTADOSI. That is right, sir, and also for the freight that we move around in our own yard with our own freight cars.

The CHAIRMAN. And you have not had a failure since October 30 on the batteries that were put in, and you have not had, throughout the winter months, the need of a booster battery to start the motors when they are cold in the morning?

Mr. PIANTADOSI. That is what our records indicate, Senator.

The CHAIRMAN. In other years, you have always figured on a cold morning that you would have to have your booster batteries to get that motor started?

Mr. PIANTADOSI. Particularly on Monday morning. It all depends on the weather, you see, the condition, how cold it is, and what not.

The CHAIRMAN. You are up there in Rhode Island?

Mr. PIANTADOSI. That is right, sir.

The CHAIRMAN. So you have colder weather.

Mr. PIANTADOSI. We have a lot of bad weather there. We not only have cold weather; we have very foggy weather.

The CHAIRMAN. Now, do you make the application of the AD–X2 yourself?

Mr. PIANTADOSI. No, sir. I have my chief mechanic and his subordinate.

The CHAIRMAN. I know. But it is done in your shop?

Mr. PIANTADOSI. Absolutely, under my supervision.

The CHAIRMAN. And do you know whether it is customary for them to pull down the battery, or do they just take the caps off and pour the powder in according to instructions?

Mr. PIANTADOSI. They have instructions from me to positively follow the instructions on the package.

The CHAIRMAN. You do not bring anybody in from the outside to have that done?

Mr. PIANTADOSI. Just the first time only.

The CHAIRMAN. The first time that you used it, that is the only time that any outside man came into your shop?

Mr. PIANTADOSI. That is right, sir.

The CHAIRMAN. After that, it was just a routine affair which your own men did?

Mr. PIANTADOSI. That is right, sir. But you see, we have not used much of that AD–X2. We only have somewhere around 300 treatments. That is all.

The CHAIRMAN. I wanted to be sure that we knew whether the battery has been serviced in any manner prior to the time that the AD–X2 was added. That is the only reason for the question.

Mr. PIANTADOSI. You see, we are going along very cautiously with this, because, after all, we have the taxpayers' money involved. We started with 24 packets, and we saw a little immediate relief, and we went on and we put it in some of our buses. Our diesel buses were hard to start in the morning, and now last winter we didn't have any trouble at all. I don't have any records of that here, because the committee only gave me an hour to get ready to come in here. That is the best that I could do. But our records indicate all of the changes in batteries.

The CHAIRMAN. You have just such a service chart on each vehicle that is under your command?

Mr. PIANTADOSI. Of course, I would like to make this clear. Yes, sir. We haven't kept any scientific records on this thing because we don't have personnel to keep them. We are fieldmen. And without the fieldmen, you cannot tell what a product will do, if it is not tried in the field. It is just like, for instance, the atomic bomb. The scientists perfected it or made it in a laboratory, and they had to go out in the field to explode it. They couldn't do it in the laboratory. That is for sure.

The CHAIRMAN. You say that you did not believe that a man could make a thorough check in a laboratory and get the full facts of the situation?

Mr. PIANTADOSI. I have all the respect in the world for scientists, but I don't believe that it can be done without the field checks, because many, many times we have people come in and ask us questions on certain things——

The CHAIRMAN. Have you been here this week?

Mr. PIANTADOSI. Yes, sir.

The CHAIRMAN. And you have heard all the testimony?

Mr. PIANTADOSI. Well, not all of it. I came here, Senator, Wednesday morning.

The CHAIRMAN. Wednesday morning?

Mr. PIANTADOSI. That is right, sir.

The CHAIRMAN. So you have heard some of the scientists?

Mr. PIANTADOSI. That is right.

The CHAIRMAN. And in your opinion, your own personal findings would not support the scientific statements?

Mr. PIANTADOSI. That is right, sir. You know, in construction work as well as——

The CHAIRMAN. Would you recommend to your superiors that it would be advisable to use this AD–X2 in all the batteries?

Mr. PIANTADOSI. Up to now, I would.

The CHAIRMAN. You would?

Mr. PIANTADOSI. From what we have found up to now, but cautiously. You see, what we should have on this—for instance, on the batteries that we are using, the life expectancy of them is 2 years under normal conditions, and in our work maybe a year and a half, because they get more abuse.

The CHAIRMAN. You would rather wait until you have had another year on the batteries that you now have a record of?

Mr. PIANTADOSI. Not quite. I would like to make some more checks, for instance, on our forklift batteries. They run into anywhere from $2,000 to $2,500 apiece.

The CHAIRMAN. Are you using AD–X2 in any of your forklifts?

Mr. PIANTADOSI. No, not yet, sir. We put it in an old battery, and we are trying to see what it will do. But other than that——

The CHAIRMAN. How long have you had it in that old battery?

Mr. PIANTADOSI. I would say offhand maybe 4 or 5 months.

The CHAIRMAN. Do you think that you see any material improvement in the battery?

Mr. PIANTADOSI. Well, it is working every day. It used to heat up before, this battery, when we put it in. Every time they would charge it, rather, before we put the AD–X2 in, the battery would heat up.

The CHAIRMAN. When the battery is receiving a charge, sometimes the language is that the battery is inclined to boil, as some of them would say.

Mr. PIANTADOSI. Yes; in some more than others.

The CHAIRMAN. Yes, heating up.

Mr. PIANTADOSI. And we put the AD–X2 in. Incidentally, this battery was recommended for scrap, too, by one of the battery companies that made a survey of all our batteries.

The CHAIRMAN. You mean that this used battery that is on the forklift had been recommended for scrapping?

Mr. PIANTADOSI. It was recommended for replacement. Let us use that word.

The CHAIRMAN. All right. The manufacturer had recommended replacing that battery. And that was about 4 months ago?

Mr. PIANTADOSI. No. They did that probably a year ago.

The CHAIRMAN. A year ago?

Mr. PIANTADOSI. Approximately.

The CHAIRMAN. And then you fussed along with it for several months, and then you decided to put the AD–X2 in it?

Mr. PIANTADOSI. We were just toying with that one. Let me be honest about it.

The CHAIRMAN. All right. Then you put the AD–X2 in how many months ago?

Mr. PIANTADOSI. Four or five months ago.

The CHAIRMAN. Four or five months ago?

Mr. PIANTADOSI. I don't remember, but I have the record.

The CHAIRMAN. Do you have the record with you?

Mr. PIANTADOSI. No; not with me.

The CHAIRMAN. All right. Then 4 or 5 months ago, you put the AD–X2 in, and you are personally watching it because of your interest in trying to do a little experimenting?

Mr. PIANTADOSI. I am not personally watching that, because that battery is assigned to the O & R Department, which is the Overhaul

and Repair Department, and they have their own charge of equipment. In other words, we give them the equipment. We supply them the equipment. Public Works spends the money to buy the batteries, and they operate it.

The CHAIRMAN. And the report that you are getting on that battery is that the battery is not heating up?

Mr. PIANTADOSI. It is the same thing, except that it is working a full 8 hours a day.

The CHAIRMAN. It works a full 8 hours a day?

Mr. PIANTADOSI. That is right.

The CHAIRMAN. And it was a battery that had been recommended to be replaced a year earlier?

Mr. PIANTADOSI. As far as I know, it was.

The CHAIRMAN. And now a year later, and having had the AD–X2 in it for the last 4 or 5 months, it is rendering service for its full day?

Mr. PIANTADOSI. That is right, sir.

The CHAIRMAN. And what is your frank opinion? Do you think it has helped you, or helped that battery?

Mr. PIANTADOSI. I think it has helped that battery; yes. I think it has. Definitely, on this AD–X2, I would want to experiment a little more in the field. You see, in the laboratory you cannot give that, in my opinion, a proper evaluation, because you have a man running a piece of equipment. Say you have four pieces of equipment alike and four different people running it, and you are going to have four different ideas and four different methods of running the equipment, and each and every one of us have our own methods of operating equipment, our automobiles. You have heard people many times say that if everybody drives a car, it gets wrecked a lot easier. And that is what happens to our equipment. Everybody drives it. Everybody runs it. And so, in order to evaluate it properly, it should be done mostly in the field.

The CHAIRMAN. Where you have normal operation?

Mr. PIANTADOSI. You see, everyone would operate it differently. They would all have their ways. They may all be good operators, but they would all work it differently.

The CHAIRMAN. But your general opinion is that it is working somehow, some way, and rendering a benefit to you?

Mr. PIANTADOSI. That is right, sir. Let me say it this way. If they were my batteries and I owned them, I would definitely put the AD–X2 in.

The CHAIRMAN. Even if you had to spend your own money?

Mr. PIANTADOSI. That is right. But spending the taxpayers' money, I want to be a little cautious to find out what may happen, because strange things happen from time to time.

The CHAIRMAN. Do you have any questions, Senator Gillette?

Senator GILLETTE. Yes, Mr. Chairman. There are a couple of questions that I wanted to ask.

The instances to which you have directed our attention, and with quite spectacular results, do they represent the only instances where you have used this additive?

Mr. PIANTADOSI. No, sir. There are more instances.

Senator GILLETTE. They are select instances?

Mr. PIANTADOSI. Yes. We have some buses that we had trouble starting in the winter. We did not have any this winter. Of course, we had a little milder winter.

Senator GILLETTE. I think you stated that you had come into the possession of 24 packages of this material?

Mr. PIANTADOSI. That was the first order. Then we had another order of 150, and approximately 160. In other words, it was around 300 in all that we have bought, roughly.

Senator GILLETTE. Have you used this in 300 vehicles?

Mr. PIANTADOSI. No, sir; cells.

Senator GILLETTE. In how many have you used it?

Mr. PIANTADOSI. These packets go one packet to a cell in a small battery.

Senator GILLETTE. Yes.

Mr. PIANTADOSI. As the batteries get larger, of course, it takes more.

Senator GILLETTE. What I am trying to find out is this: Are these selective instances of valuable improvement results, or are they normal or average?

Mr. PIANTADOSI. In every case, it showed definite results, good results.

Senator GILLETTE. But you selected these as showing the most outstanding results?

Mr. PIANTADOSI. That is right.

Senator GILLETTE. How many batteries would you say you had used this material in?

Mr. PIANTADOSI. I would say possibly 100 batteries, 90 to 100 batteries.

Senator GILLETTE. Would it be your testimony to us that in most of these, if not all of them, there was improvement in performance?

Mr. PIANTADOSI. I would say in most of them there was improvement in performance.

Senator GILLETTE. Was there failure in some?

Mr. PIANTADOSI. To the best of my knowledge, I have not heard of a failure.

Senator GILLETTE. But the fact remains that you selected these as showing the most spectacular results?

Mr. PIANTADOSI. That is right. When I got the telegram, Senator, to come down here, I got my quarterman in, and I wanted to know if these vehicles still had the batteries in which we installed the AD–X2 in. So we looked in our records. And the time that I had before I left was very short, and the best I could do was to get these few cases together.

Senator GILLETTE. But from all your experience with it, it is your considered judgment that it has merit, that this material has merit so far as you have been able to determine from your use of it?

Mr. PIANTADOSI. Definitely.

Senator GILLETTE. And you yourself would think you were justified in spending your own money in using it in your batteries?

Mr. PIANTADOSI. Definitely.

Senator GILLETTE. That is all, Mr. Chairman.

The CHAIRMAN. What is the approximate cost of the batteries that you used in that locomotive?

Mr. PIANTADOSI. I thought I gave that. It is between $96 and $98, Senator. I don't know.

The CHAIRMAN. Yes. You have given us the $96 to $98 figure. But I was not certain whether that was your locomotive.

Mr. PIANTADOSI. That is right.

The CHAIRMAN. And then what is the approximate cost of the batteries used in the forklift?

Mr. PIANTADOSI. The forklift batteries, now, run anywhere from $1,000 to $2,600. It all depends on the type of battery.

The CHAIRMAN. From $1,000 to $2,600?

Mr. PIANTADOSI. The lead-acid batteries run around $1,000 to $1,400, actually what is used.

The CHAIRMAN. I see. One thousand dollars to $1,400. So if you could extend the life of those by 6 months or a year, it would be a substantial saving?

Mr. PIANTADOSI. We would have to evaluate them. On the life of a battery, if the manufacturer says it is 5 years, we would have to prorate it, and so forth and so on, before we could——

The CHAIRMAN. Do you recall how many packages, or the approximate cost of adding the AD–X2 to the forklift battery?

Mr. PIANTADOSI. What is that, sir.

The CHAIRMAN. The approximate cost of the powder that was necessary to treat this forklift battery, where you have a cost of anywhere from $1,000 to $2,600?

Mr. PIANTADOSI. Offhand, I would not.

The CHAIRMAN. You see, there you would use a great number of packages because of the size of the battery.

Mr. PIANTADOSI. That is right. Offhand, I would have to find out what size battery, and so forth, and again look at the instructions.

The CHAIRMAN. I see. That is the only questions I have.

Senator GILLETTE. Just one other question. This is for my own information.

I was very much astonished at your report of the need for recharging or changing these batteries every few days or every few months. Would you ascribe that to a defective battery or a vehicle that was sapping the strength of the battery, or the carelessness of an operator?

Mr. PIANTADOSI. That could be many, many things. These particular vehicles, all but the locomotive, have two-way radios in. That has a definite drain on the battery. But on others, where the changes are abnormal or more than usual, in many cases, or 90 percent of the time, it is because of the human element. We have vehicles in the pool, and John Smith comes up. He has a driver's license. We check that he has—whether he is military, a sailor, or an officer, or a civilian. We don't have the men to operate the pool, you see. We only have a few men in the activities who drive their own vehicles. So they send their men up, and we give them a vehicle. We go out there and give him the keys, and he gets in that vehicle and turns the key on, and, in 9 out of 10, he goes, and the other one he does not. He probably chokes it up, through characteristics of his driving; or the car itself fails to start. They don't come in to you when they don't start a car in most instances and tell you that car won't start. They just run the battery down.

Senator GILLETTE. That is all, Mr. Chairman.

The CHAIRMAN. Thank you, sir.

The next person is Mr. Rossell. Will Mr. Rossell come forward?

Mr. Rossell, do you swear that the testimony you are about to give pertaining to the matter now before this committee is the truth, the whole truth, and nothing but the truth, so help you God?

Mr. ROSSELL. I do.

TESTIMONY OF OLIN ROSSELL, EMPLOYEE, UNITED STATES NAVAL SUPPLY BASE, STOCKTON, CALIF.

The CHAIRMAN. You may proceed. You may, for the sake of the record, state where you are employed and by whom, and what your duties are there, and then proceed in whatever manner you wish to give us your statement.

Mr. ROSSELL. At the present time, I am employed by the United States Navy as an automotive mechanic. I want it understood that I am now—I haven't been in the battery shop since November of 1949.

The CHAIRMAN. November of 1949.

Mr. ROSSELL. That is another story. But I have a statement or an affidavit here that I would like to submit as part of my testimony.

On September 20, 1949, I sent the following affidavit to E. U. Condon, Director of the National Bureau of Standards, Washington 25, D. C.:

DEAR SIR: I have been building, repairing, and doing battery maintenance work for over 10 years. At the request of the manufacturer, I submit the following factual statements on Battery AD–X2 as manufactured by Pioneers, Inc., 2411 Grove Street, Oakland, Calif.

In the application of several hundred treatments of Battery AD–X2 to badly sulfated batteries, I have not seen one instance where Battery AD–X2 has failed to desulfate a battery, regardless of the degree of sulfation. I know that many of these batteries were too badly sulfated to take a normal charge. However, as an example, I cite one set of batteries, diesel locomotive, 32 cells in all, not less than 4 years old. Several attempts had been made over a 6-month period to bring these batteries to charge. They were finally condemned and sent to the shop where I work. I spot-checked the cells, determined that the batteries were mechanically sound and treated them with Battery AD–X2. The batteries came to full charge and are now back in the locomotive and giving trouble-free service. The batteries have a value of $700 and the cost of treating them with Battery AD–X2 was under $100.

I am familiar with Circular Letter 302 published by the National Bureau of Standards and the pamphlet, Battery Compounds and Solutions, put out by the National Better Business Bureau. It is my opinion that these publications are definitely unfair to Pioneers, Inc., and to the public who would benefit by the use of the Battery AD–X2.

Although I am employed as battery man at Stockton Annex, Naval Supply Base, Rough and Ready Island, Stockton, Calif., I make these statements as an individual and not as an employee of the Navy.

I am not connected with Pioneers, Inc., in any way. However, I am interested in promoting dissemination of correct information to the public and have heretofore made these statements at the request of Pioneers, Inc.

I have no reason to change my mind concerning the effectiveness of Battery AD–X2 since sending this affidavit.

Now, for detailed experience, Mr. Chairman, I would like to——

The CHAIRMAN. Mr. Rossell, before we get away from that affidavit, had anyone solicited you and asked you to write and to make this affidavit and send it to the Bureau of Standards laboratory?

Mr. ROSSELL. No, sir.

The CHAIRMAN. You mean that neither Mr. Ritchie nor any salesman of the product did, but the question had come to you because you had seen the pamphlet?

Mr. ROSSELL. That is right.

The CHAIRMAN. You had read about the controversy, and you yourself being familiar with the battery, and you yourself having this experience with this large battery and its reaction after you had made the application of the AD–X2 compound, that was your conviction, and nobody had urged you to send this affidavit?

Mr. ROSSELL. That is right.

The CHAIRMAN. And you were then employed by the Navy?

Mr. ROSSELL. That is right.

The CHAIRMAN. And you knew what the battery maintenance cost was?

Mr. ROSSELL. That is right.

The CHAIRMAN. And you just had a feeling that you could save not only in battery costs, but you could save the Government money in the time required to charge and change these batteries in the units that they were in use in?

Mr. ROSSELL. That is right.

The CHAIRMAN. Whether it was a locomotive or an automobile vehicle?

Mr. ROSSELL. That is right.

The CHAIRMAN. And that was the reason? It came from your heart, in other words?

Mr. ROSSELL. It came from my heart. I feel very deeply.

The CHAIRMAN. It came from your heart to send this affidavit?

Mr. ROSSELL. I feel very deeply about this.

The CHAIRMAN. You may proceed.

Mr. ROSSELL. Mr. Chairman, I would like to speak of the first battery I treated, and some in the fire station and batteries in storage.

Now, in October of 1948, Mr. Ritchie was brought to the shop by my supervisor, Mr. Mason, and was introduced to me. So, Mr. Ritchie told me his story, and I was very reluctant, because I had had a lot of experience in testing additives of different kinds, not mentioning any names. But, to me, battery additives were dynamite. I didn't like them. The fact is, I was prejudiced. So I didn't want to fool with them.

But Mr. Mason is kind of a curious man. He wanted to know what would happen. He said, "Well, it ain't going to cost us anything." He said, "Let's try it."

So I says, "O. K."

Now, here is the point that I want to bring out. At that time I was very unfair, because I went and got a little 80-ampere battery that was destined for the junkyard. I had set it out for scrap. So we disassembled the battery, looked it over, and both Mr. Ritchie and myself looked at it, and there were no defects of any kind. It was mechanically sound. So, as per instructions, I reassembled the battery, and, as per instructions, we treated it, and I put it on the line for 20 hours at a 5-ampere rate.

In the meantime, Mr. Ritchie had gone back to Oakland. So at the time that I put it on the line I could only get a gravity of 1.200 on all 3 cells. However, all 3 cells were 1.200. On the first charge, after 20 hours, with the treatment of 2 cells with battery AD–X2, they were 25 points higher than the cell that was untreated.

The CHAIRMAN. In other words, there were three cells in that battery?

Mr. ROSSELL. That is right.

The CHAIRMAN. And you put AD–X2 in two cells?

Mr. ROSSELL. That is correct.

The CHAIRMAN. And you left one cell untreated?

Mr. ROSSELL. Untreated.

The CHAIRMAN. Now, had you been instructed to do that?

Mr. ROSSELL. Mr. Ritchie instructed me to do that.

The CHAIRMAN. I see.

Mr. ROSSELL. As a comparison.

The CHAIRMAN. So that you would get a reading from two cells treated and a reading from the third cell that was not treated?

Mr. ROSSELL. That is right. And I am only working with one battery.

The CHAIRMAN. That is right. Now, you said that the two treated cells had a reading of what?

Mr. ROSSELL. Approximately 1.225 after a 20-hour charge at 5 amps.

The CHAIRMAN. What did the untreated cell read?

Mr. ROSSELL. Still 1.200.

The CHAIRMAN. Still 1.200. You had 25 points higher on the 2 treated cells?

Mr. ROSSELL. Yes, sir; that is right. Now, what I did was take the battery and put it on discharge at a 10-amp rate. And I pulled all 3 cells, then, down to around 1.150.

The next day I put the battery back on charge, and the 2 cells that were treated came up to 1.275 this time.

The CHAIRMAN. What was the reading on the untreated cell?

Mr. ROSSELL. The untreated cell was still 1.200. That is the last time I charged it on the line. I treated the other cell with the envelope of material that I had.

Then, with my supervisor's permission, I put that battery in my car, and I used the battery in my car for 3 weeks, thinking every night when I went out I was going to have to be pushed to get home, or when I started out in the morning, I was going to have to be pushed to get to work. Now, that is the way I felt about it. But I didn't have any trouble. So at the end of 3 weeks Mr. Ritchie came back to the shop, and he asked me how the battery was doing. I said, "Well, so far it is doing O. K." I said, "It is doing a good job."

He asked me where it was, and I told him. So we got hold of Mr. Swinford, who was the chief quarterman of public works in the automotive division, and Mr. Ege, Mr. Rempert, Mr. Mason, and myself, and we all went out to the car. So at Mr. Ritchie's suggestion, I got into the car, and I stepped on the starter and, without the key on, I turned this engine, a V–8 engine in a Ford, for 13½ minutes, with the lights burning on high beam.

Now, if I tell you we were surprised, that is putting it mildly. But I still was not satisfied. I was wondering what this material was going to do to the plates, because I had had an experience before. I was wondering if it was going to soften the material up and let it drop out of the grids.

So I took the battery back out of the car and took it back in the shop. In the meantime, Mr. Ritchie left me four more packages, and told me to test some more batteries with it. So during the test on these other four batteries, I followed the same procedure that I did on this one. In the meantime, I was giving this little battery, the first one that I had treated—I was giving it the works. Believe me, I was! What I did, every morning for 10 days I came into the shop. The first thing I did was to put this little battery on charge at 35 amperes for 2½ hours. Then I would take it off the charge, let it sit for 1 hour, and I would put it on the discharge at 50 amperes

until it was dead. And I did that every day for 10 days. And then I took the battery apart and looked at it. And I can say this, that there were no ill effects any place from the use of Battery AD–X2.

The CHAIRMAN. Mr. Rossell, how many batteries have you treated with the compound?

Mr. ROSSELL. Mr. Chairman, that is difficult to say. It would be like asking me how many cigarettes I smoked a year ago. I don't really know. But it was well over 1,000 treatments.

The CHAIRMAN. You mean that you made well over 1,000 battery treatments?

Mr. ROSSELL. That is right. Well, not necessarily 1,000 batteries; no. But what I mean is, I have used well over 1,000 treatments. Some batteries would take two packages, and your larger batteries will take more than that. But I have used well over 1,000 treatments.

The CHAIRMAN. Now, what type of batteries have you treated?

Mr. ROSSELL. The large percentage of my treatments were in batteries for automotive equipment.

The CHAIRMAN. When did you first start using it? Was that in 1949?

Mr. ROSSELL. Now, on the basis of this test that we made, my supervisor and his supervisors, in turn, through the proper channels, ordered Battery AD–X2. Now, it was sometime later in the winter, well, in the late fall or early winter of 1948, before we had any Battery AD–X2 to treat batteries with. But when the AD–X2 came in, I treated all batteries in the shop, that is, all automotive batteries in the shop.

The CHAIRMAN. Did you have any other batteries besides automobile batteries?

Mr. ROSSELL. Yes. We had some large industrial batteries, that is, in fork-lifts. But I did not treat these at that time. What we were interested in mainly was to stop so many battery changes in small batteries in automotive equipment and handling equipment on the base. And there were a lot of us working; and we were having battery trouble at that time.

The CHAIRMAN. How long would it take a man to change those batteries in the trucks and jeeps and all those vehicles that you had to use?

Mr. ROSSELL. That is hard to say, but ordinarily a troubleshooter, as we call them—a man who goes out from the shop to the field when there is trouble—if he gets a call that they have a dead battery, from the time he leaves the shop and goes out and changes the battery and gets back, he has spent approximately a half-hour, depending on what part of the base he has to go to.

The CHAIRMAN. And, then, whoever was waiting because of the failure of the battery just added some additional man-hours lost?

Mr. ROSSELL. That is true.

The CHAIRMAN. And then you would have, of course, to bring the battery in and charge it up?

Mr. ROSSELL. That is right.

The CHAIRMAN. And, of course, you have a little expense in the cost of charging the battery up. But when did you start using it in the larger batteries?

Mr. ROSSELL. I never did use it—I only treated one large battery, just one, that we were having trouble with.

The CHAIRMAN. What kind of battery?

Mr. ROSSELL. It was in a Yale fork-lift.

The CHAIRMAN. And how expensive was that battery?

Mr. ROSSELL. That battery weighed approximately 3,000 pounds, and I was told by my supervisor that that battery would cost somewhere in the neighborhood of $2,700.

The CHAIRMAN. $2,700. Now, how old was that battery?

Mr. ROSSELL. I think that it had been in use since 1945. Whether it was a new battery when I first came there or not, I do not know.

The CHAIRMAN. But it had been in use since 1945?

Mr. ROSSELL. That is right.

The CHAIRMAN. And when did you treat it?

Mr. ROSSELL. In the spring of 1949.

The CHAIRMAN. Spring, 1949. And what is the history? How long did it continue to operate?

Mr. ROSSELL. Well, in the spring of 1949; up until November of 1949, the battery was still in operation.

The CHAIRMAN. In November of 1949, the battery was still in operation?

Mr. ROSSELL. And was doing a good job.

The CHAIRMAN. And it was marked for discard at the time that you worked on it?

Mr. ROSSELL. It would not have been long until it would have been marked for discard, because we were having trouble with it.

The CHAIRMAN. You mean it would not last throughout the day?

Mr. ROSSELL. That is right.

The CHAIRMAN. So they would charge it overnight and would start it out in the day; but sometime in the afternoon the battery gave out?

Mr. ROSSELL. That is right.

The CHAIRMAN. So that you would have the loss of time to get another unit there?

Mr. ROSSELL. That is true.

The CHAIRMAN. Now why haven't you followed it since November of 1949?

Mr. ROSSELL. That is the other story. When I went to work at the base in 1945, I went to work as an automotive mechanic. In October of 1945, I was put in the battery shop, still with the automotive mechanic's rating, because there was no rating in the Navy at that time for a battery man. So in the last part of October 1949—did I say 1945? October 1945?

The CHAIRMAN. You first gave us a date of 1945, and then you gave us a date of the spring of 1949, and then the next date was November of 1949.

Mr. ROSSELL. Well, I meant—here is what I should have said. I was a little bit ahead of myself. In October of 1945 I went to work in the battery shop as an automotive mechanic, and was put in the battery shop in charge of batteries, because at that time there was no rating in the Navy for battery man.

In the last part of October of 1949 I got an RIF, reduction in force, so they immediately—the fight then was between the Civil Service Commission, or the Civil Service Commission rules and my supervisor. There wasn't anything they could do about it, except try to get through a rating for a battery man, which they did. But I was asked to take a substantial cut in wages and still do the same work—that is the way

the order come through. I didn't like it, and I resigned. In August of 1950 I came back to the Navy in the same capacity, in the same building, as an automotive mechanic, and I have been working there since.

The CHAIRMAN. But you lost track after 1949?

Mr. ROSSELL. I lost track of this large battery.

The CHAIRMAN. November of 1949?

Mr. ROSSELL. That is right.

The CHAIRMAN. So you have no history of whether this battery stayed on the line very long after that or not. But did that battery show any improvement from the time that you treated it in the spring of 1949 up until November of 1949?

Mr. ROSSELL. That is right; it did, remarkable improvement.

The CHAIRMAN. It showed improvement?

Mr. ROSSELL. Yes, sir.

The CHAIRMAN. In order to be certain that you did not misunderstand my question about the affidavit—because you are sworn here, and we do not want to embarrass you in any manner—my question was, Had anyone asked you to prepare that affidavit?

Mr. ROSSELL. No.

The CHAIRMAN. You are not related to Mr. Ritchie?

Mr. ROSSELL. In no way; no.

The CHAIRMAN. And you have no interest in Mr. Ritchie's business?

Mr. ROSSELL. No, sir.

The CHAIRMAN. Did Mr. Ritchie urge you to prepare this affidavit to be sent to the Bureau of Standards?

Mr. ROSSELL. No. He wrote a letter to me.

The CHAIRMAN. One reason I asked that question is that counsel has brought the affidavit to my attention, and I have a copy here, and this was dated September 19, 1949, wherein it is stated:

> I am not connected with Pioneers, Inc., in any way. However, I am interested in promoting dissemination of correct information to the public and have, therefore, made these statements at the request of Pioneers, Inc.

I did not want this printed affidavit to conflict with your answer to me, you see.

Mr. ROSSELL. Well, I see now what you mean.

The CHAIRMAN. Yes, sir.

Mr. FORSYTHE. Mr. Rossell, the chairman has given me permission to ask you some questions. I just want to point out that we want to clear the record for you and for us and everybody who is here. Mr. Ritchie's product was on the market, and you were aware of the document 504; that is correct, is it not?

Mr. ROSSELL. No; not document 504; 302.

Mr. FORSYTHE. And Mr. Ritchie, being interested in his product, and the conflict with 302, requested you to write the affidavit suggesting your findings on AD–X2?

Mr. ROSSELL. That is correct.

Mr. FORSYTHE. Did you make the affidavit before you had used AD–X2, or was your affidavit based upon your actual experience with AD–X2?

Mr. ROSSELL. This affidavit is based on actual experience.

Mr. FORSYTHE. It was not then written before you had ever seen the product or used it yourself?

Mr. ROSSELL. Oh, no.

Mr. FORSYTHE. Mr. Ritchie did not come around and say, "I have got a product, and you write Dr. Condon about it"; that is what I am getting at?

Mr. ROSSELL. No, sir; because, after all, as pointed out in this story, I told you I was very reluctant to use it. I was prejudiced; I didn't like additives.

Mr. FORSYTHE. All right. Now, is it not true that you received a communication from the chairman of this committee requesting you to come here and testify in person?

Mr. ROSSELL. That is true.

Mr. FORSYTHE. Is it not true that your commanding officer gave you full cooperation in coming here?

Mr. ROSSELL. That is true.

Mr. FORSYTHE. The statements that you are making here on the stand were not requested or written for you by Mr. Ritchie, but you are giving them as a private citizen from the knowledge that you have of AD–X2?

Mr. ROSSELL. That is true.

Mr. FORSYTHE. The only reason you came here is because Senator Thye wrote you a communication and requested your presence because you had knowledge of AD–X2?

Mr. ROSSELL. That is true.

Mr. FORSYTHE. That is all.

The CHAIRMAN. Senator Hendrickson, do you want to ask any questions?

Senator HENDRICKSON. I fear, Mr. Chairman, coming in late, as I did, any questions I might ask might be duplication. Has the witness testified as to the original contacts with Mr. Ritchie?

The CHAIRMAN. Yes, he has.

Senator HENDRICKSON. It is in the record?

The CHAIRMAN. It is in the record?

Senator HENDRICKSON. How they met each other?

The CHAIRMAN. That Mr. Ritchie came in and tried to sell the product, and he gave the history of his experience.

Mr. ROSSELL. No, he didn't come in and try to sell the product. He came in and urged me to make a test on it.

The CHAIRMAN. Anyway, Mr. Ritchie was present when that first battery was treated?

Mr. ROSSELL. That is true.

Senator HENDRICKSON. When this first battery was treated, Mr. Rossell, you said in your testimony, as I understood it, that you had been unfair to Mr. Ritchie; is that correct?

Mr. ROSSELL. I was unfair in this respect: That I realize now that, or realized later that, I was unfair at the time—as I say, I was prejudiced. I didn't want any part of it, and Mr. Ritchie told me what the product would do, and I was going to attempt to prove the man wrong. That was my idea for picking out the oldest——

Senator HENDRICKSON. I assume that statement, because you were prejudiced, means that you went out of your way to try to prove that he was wrong; is that what you mean?

Mr. ROSSELL. That is true, very true.

Senator HENDRICKSON. I have no other questions.

The CHAIRMAN. Have you any further statement you would like to make, Mr. Rossell?

Mr. ROSSELL. No, I don't believe so.

The CHAIRMAN. Well, thank you.

Let me say that there was no one subpenaed. We sent out invitations to all. We have issued no subpenas. They have volunteered—the military forces have permitted the men to come in.

The next witness is Mr. Harrell. Is Mr. Harrell here?

Mr. Harrell, raise your right hand. Do you swear that the testimony you are about to give pertaining to this matter before this committee is the truth, the whole truth, and nothing but the truth, so help you God?

Mr. HARRELL. I do.

TESTIMONY OF FREDERICK ATWOOD HARRELL, BATTERY SHOP OWNER, ARLINGTON, VA.

The CHAIRMAN. Mr. Harrell, will you tell us where you are employed, by whom, and what your duties are?

Mr. HARRELL. My name is Frederick Atwood Harrell. I am self-employed. I own a battery place at 3904 Wilson Boulevard, Arlington.

The CHAIRMAN. You are self-employed?

Mr. HARRELL. Yes, sir.

The CHAIRMAN. You run a battery service station?

Mr. HARRELL. I do; I am the proprietor of it.

The CHAIRMAN. All right. Then you may proceed to tell us when you first became interested in AD–X2—what year was it?

Mr. HARRELL. I like to start this way: In my business I rebuild and repair all of the serviceable batteries that I can get hold of.

The CHAIRMAN. All the serviceable batteries?

Mr. HARRELL. That is right; that have been discarded.

The CHAIRMAN. In other words, they are junked batteries?

Mr. HARRELL. That is correct.

The CHAIRMAN. Do you take and tear down several batteries and salvage the serviceable cells and rebuild batteries from that?

Mr. HARRELL. I do; yes.

The CHAIRMAN. Then you resell them?

Mr. HARRELL. That is so.

The CHAIRMAN. At what price?

Mr. HARRELL. It depends on whether it is an individual or to a used-car dealer. Most of my sales are to used-car dealers on that stuff.

The CHAIRMAN. About how much do you get for it?

Mr. HARRELL. I get for a group 1 battery $7 exchange.

The CHAIRMAN. $7 from an old dead battery?

Mr. HARRELL. That is right; I get $7 exchange.

The CHAIRMAN. In other words, the rebuilt battery that you trade to the used-car dealer, you get an old battery back?

Mr. HARRELL. That is right.

The CHAIRMAN. And he pays you $7?

Mr. HARRELL. That is right.

The CHAIRMAN. Then you start overhauling the battery, taking the good parts out of it?

Mr. HARRELL. If it is worth it.

The CHAIRMAN. And putting it back into another case?

Mr. HARRELL. Another case, or whatever is necessary.

The CHAIRMAN. I see. That is how you proceed.

When did you first get acquainted with the AD–X2 product?

Mr. HARRELL. Well, all of my life I have had trouble with hard, sulfated plates in these batteries, and I have always hunted for something to overcome that.

The CHAIRMAN. How many years have you been in the battery business?

Mr. HARRELL. I have been in the battery business for over 32 years.

The CHAIRMAN. You have seen a few batteries?

Mr. HARRELL. I have. I saw AD–X2 advertised in a trade magazine that I subscribed to. One paragraph in there stated that a well-built rebuilt battery treated with AD–X2 would go out and work like a new battery. Naturally, when I saw that I was interested. That was in the fall of 1951, around October, something like that.

Well, I didn't lose any time in getting hold of some AD–X2 after I saw that. I commenced trying it out on batteries that had hard, sulfated plates in them. The plates responded to treatment. What I mean by that is that after treatment with AD–X2 the sulfate would be superior; it would be porous and soft, and it was an aid to me—it eliminated a lot of comebacks from these used-car lots. When you have a car standing on the lot for from 4 to 6 weeks, and you do not sell it, and you start it 2 or 3 times a week, the battery is going to run down. The dealer is going to bring it back to you or call you up about it, and he is going to want a battery replacement for his car.

Well, since I started using AD–X2 I have eliminated that. I don't have that trouble any more.

The CHAIRMAN. Would you charge more for a treated battery?

Mr. HARRELL. No, I never charge more for treating a battery, just like I never say anything to them. I sell them a battery for a price.

The CHAIRMAN. In other words, where you felt you were getting your money's worth out of it was that you did not have the comeback.

Mr. HARRELL. That is right.

The CHAIRMAN. You did not have the problem of furnishing them another battery.

Mr. HARRELL. That, and another thing, I have been able to salvage batteries that, before I started using AD–X2, I had been discarding.

I started experimenting with AD–X2 right after I received it, along in January and February and March in 1952. Then, I think it was May 1952, when Mr. Ritchie came over to my shop.

The CHAIRMAN. Was that the first time you had met him?

Mr. HARRELL. Yes, sir. He asked me about AD–X2, what I thought about it, and so forth, after he found out I had been using it. I told him, and he said he wanted to make some experiments at the Bureau of Standards. He asked me if I would get him some batteries that were in proper condition for experimental purposes. He wanted some that were sulfated.

I told him, yes, I would. He said he wanted about 30. Well, I started collecting these batteries; I got about half of them together, and then Mr. Ritchie told me that he didn't want them. He said the Bureau was getting some batteries of their own, that they were going to make some tests with.

Around the 1st of June, the Bureau of Standards, with a truck-driver and Mr. Snyder, sent about 20 big old batteries over to my place. I guess they were about this long—they were 12-volt batteries, paralleled into 6 volts.

The CHAIRMAN. What were those big batteries used for?

Mr. HARRELL. The only thing I ever saw them used for was for lighting plants out in the country about 20, 25 years ago; I never saw any on a starter or——

The CHAIRMAN. Used for what purpose?

Mr. HARRELL. Lighting plants.

The CHAIRMAN. In other words, farm lighting plants?

Mr. HARRELL. That is correct.

The CHAIRMAN. Where they have a small generating unit and were driven by a gasoline engine?

Mr. HARRELL. They were thick, heavy plates and, as I say, they were 12 volts paralleled into 6 volts. I think that was for capacity.

They wanted those batteries pulled down, inspected, and reassembled into 6-volt units.

Well, I did it. It took about 3 days. Some of those batteries are around 5 or 6 years old, and the plates had expanded and swelled up in there, and we had quite a time in getting some of them out. In fact, there were 2 or 3 of them we couldn't get out. None of those batteries were sulfated to the extent that they contained white crystals; in fact, two of the batteries I rejected as being unfit for a test because they had been recently charged and were in a charged condition at that time. But we did get about 15 or 16 of them that I assembled for these tests.

Mr. Snyder, of the Bureau of Standards, was at my shop continuously while I was preparing these batteries for the tests, and while we were looking at them, and discussing them there one day I said, "Mr. Snyder, these plates are hard. When these batteries are put on charge and begin to take a charge you are going to have to draw off some of the acid if you treat them with AD–X2. If you don't, they will get hot, and the acid will rise on them."

I don't know what was done. I was told that wasn't done, and the acid did go way up above 1.300 specific gravity.

I wasn't permitted to see the tests or anything about them. After I got through with the batteries, I took them in my truck, carried them to the Bureau of Standards, hauled them off there on the floor. I asked Mr. Snyder if I could see those batteries treated with AD–X2 and if I could see the tests and make comparisons. I thought by working in conjunction with some scientists there that I would learn something—I would find out something I didn't know.

Mr. Snyder advised me that I couldn't see the batteries tested, because I wouldn't know anything about what cells were to be treated or anything; that the only one that would know anything about that was Dr. Astin.

Well, it kind of hurt me a little bit, and I was disappointed, because I had worked on those batteries hoping to find out something about them. I didn't charge anything for the work, neither the Bureau of Standards, nor Mr. Ritchie. What I did was gratis. What I did want was to learn something more about batteries, how they worked, and so forth; but there was nothing I could do about it.

They got through with their tests in about 5 or 6 days after that, and they called me back over there to pull the batteries down for visual inspections.

I pulled the batteries up out of the cells, pushed them back down that day. The next day they came back for visual inspection. I went over there, and there were quite a number of people over there seated around tables, and all of them had reports about this size, and the plates were brought to us on a tray; each plate was broke off of a cell, and brought around on a tray, and you were supposed to write down your report on whether you thought it was treated with AD–X2 or not, and the density of it, and the color of it, and the general description.

The CHAIRMAN. How many days, now, was this after the time that they got the batteries from you?

Mr. HARRELL. I think it was about 5 days.

The CHAIRMAN. About 5 days later? They had had the batteries 5 days, and somewhere around the fifth day these batteries were torn down?

Mr. HARRELL. They were pulled out again by me.

The CHAIRMAN. You pulled them apart?

Mr. HARRELL. I did.

The CHAIRMAN. You separated all the cells?

Mr. HARRELL. I didn't separate the cells; they did it there; they separated the cells.

The CHAIRMAN. In other words, all you did was to open up the case so that these cells could be lifted out?

Mr. HARRELL. I cut the connectors.

The CHAIRMAN. Yes.

Mr. HARRELL. Took the compound away from around the cells, the sealing compound, lifted them up and put them back down.

The CHAIRMAN. But they were free?

Mr. HARRELL. They were free; that is correct.

The CHAIRMAN. In the case?

Mr. HARRELL. That is correct.

The CHAIRMAN. After you had done that, then you did not see them again until they were brought in on a tray?

Mr. HARRELL. That is right; and that was the next day.

The CHAIRMAN. That would be the sixth day?

Mr. HARRELL. That is right.

The CHAIRMAN. And then all of those that were supposed to be experts and scientists, and so forth, were going to try to determine what change had taken place in the plate?

Mr. HARRELL. That is right.

The CHAIRMAN. What was your opinion?

Mr. HARRELL. I never could find out. I asked them for a check report on my findings there, because I wanted to compare my report with what they treated. I also asked them for a report on the whole thing, the results of their findings, but they never gave it to me.

Senator HENDRICKSON. Mr. Chairman, may I ask a question?

The CHAIRMAN. Senator Hendrickson.

Senator HENDRICKSON. Where was this test made?

Mr. HARRELL. It was in the Bureau of Standards, so far as I know; I wasn't present.

The CHAIRMAN. But they had the batteries 5 days?

Mr. HARRELL. Yes, sir.

The CHAIRMAN. Whatever they did in that period of 5 days you are not familiar with?

Mr. HARRELL. I don't know.

The CHAIRMAN. You do not know?

Mr. HARRELL. No, sir.

The CHAIRMAN. What part of a cell did you look at when it was on the tray in front of you?

Mr. HARRELL. Positive and negative plates, we looked at both, and those batteries were completely destroyed, too.

The CHAIRMAN. What do you mean, they were completely destroyed?

Mr. HARRELL. All the plates were broke off at the shoulders and when they got through with them punching and gouging on them, they were dumped over into a barrel.

The CHAIRMAN. In other words, when they dissected these cells, took the plates, the positive and negative plates, apart, they naturally would have to saw the segments or cut them, or something.

Mr. HARRELL. Well, no, you can take them apart whole. You can take them apart—they will slip right in—they slip in right like fingers.

The CHAIRMAN. Yes, I know that.

Mr. HARRELL. But they didn't do that.

The CHAIRMAN. But one series were connected above?

Mr. HARRELL. They were cut off.

The CHAIRMAN. That is what I am getting at. You can separate them.

Mr. HARRELL. Yes.

The CHAIRMAN. You can separate the separators that are inside, from the others, but they have all got to be connected, otherwise you have not got a battery.

Mr. HARRELL. That is correct.

The CHAIRMAN. They were all separated?

Mr. HARRELL. They were separated and cut off from the shoulders.

The CHAIRMAN. Do you have any difficulty when you separate them, and do you use a hacksaw or something to cut them, and is that apt to injure them?

Mr. HARRELL. That is the finish of it.

The CHAIRMAN. I know it is the finish, but I mean——

Mr. HARRELL. You can't put that battery back together any more.

The CHAIRMAN. I am aware of that. But are you apt to crack them while you are going through the process of cutting them apart, is what I am getting at.

Mr. HARRELL. You are liable to shake some of the material out of the grid.

The CHAIRMAN. Yes.

Mr. HARRELL. You will do that.

The CHAIRMAN. What you refer to, the grid, is the wire network that is in there, and then the other is the lead, which is fastened to that grid or that wiring? That is all that you had before you, one of these separated cells that the testers were going to look at to determine whether there was any change in it or to give their opinion about it?

Mr. HARRELL. That is correct; that is all I was permitted to see or to note.

The CHAIRMAN. What was your opinion?

Mr. HARRELL. I could never find out. Some of the plates there that did look better than others—they were all in codes, and I wrote down under the code which I thought was the best, but I couldn't find out anything further than that.

The CHAIRMAN. These were old batteries when they came to you for the purpose of getting them ready for the Bureau of Standards to test?

Mr. HARRELL. I wouldn't say I rebuilt them. I pulled them down for inspection.

The CHAIRMAN. Yes; but they were old batteries?

Mr. HARRELL. They were.

The CHAIRMAN. You say that two batteries were in such deteriorated condition that you couldn't even put them in condition?

Mr. HARRELL. I couldn't even pull them out of the case; they were expanded so that you couldn't pull them out.

The CHAIRMAN. Were those batteries used?

Mr. HARRELL. They weren't used at all, those two.

The CHAIRMAN. The other batteries that you did service were the ones that were used in the test.

Mr. HARRELL. That was part of the same lot; yes.

The CHAIRMAN. This was in what year?

Mr. HARRELL. June 1952.

The CHAIRMAN. June of 1952?

Mr. HARRELL. Yes, sir.

The CHAIRMAN. All right. Go ahead and tell us what else you want to.

Mr. HARRELL. Well, on that test I wanted to be permitted to see the capacity test, the voltage test, and the hydrometer readings, but I was not permitted to see any of it, so I don't know—it is a perfect blank so far as I am concerned.

I was permitted to look at the plates after they were torn to pieces. Now I have heard that those batteries were tested again 6 months after that, but that is impossible. They were destroyed in my presence.

The CHAIRMAN. Those batteries were destroyed?

Mr. HARRELL. They were.

The CHAIRMAN. No man could ever have reassembled them no matter what kind of an expert he was?

Mr. HARRELL. No, sir. Once those necks have been torn off, those shoulders off of an old battery you can't put it back together, you can't fuse it back.

The CHAIRMAN. You said that after they got through inspecting them on the trays they were dumped in a barrel?

Mr. HARRELL. They were dumped into a barrel.

The CHAIRMAN. Do you want to tell us anything else?

Mr. HARRELL. Well, that is about all that I can tell you about that. But now there has been some discussion here about testing, laboratory tests, and field tests.

In my opinion, a field test is the only practical test for anything, that is, performance, because a battery that you test in a laboratory, or in a shop, is only the first step. Tests aren't any good in shops or laboratories. The only test, in my opinion, as to whether the battery you sell is good or not is whether it does a good job for the man who has paid for it.

I am running tests on batteries in some of the biggest fleets in this vicinity.

The CHAIRMAN. You have been in the battery business 32 years, and you handle quite a few batteries in a year?

Mr. HARRELL. Yes, sir; I have.

The CHAIRMAN. About how many batteries do you handle?

Mr. HARRELL. A year?

The CHAIRMAN. Yes.

Mr. HARRELL. Around 6,000.

The CHAIRMAN. You handle as many as 6,000?

Mr. HARRELL. Yes, but they are not all repair jobs. My repair jobs will run around 2,000 a year.

The CHAIRMAN. Your repair jobs. Are you treating all of these batteries now?

Mr. HARRELL. No, sir; I don't treat all of them.

The CHAIRMAN. Why don't you?

Mr. HARRELL. Well, for the first thing, it runs my expense, it runs my costs, higher.

The CHAIRMAN. But you told us that you had less returns.

Mr. HARRELL. I do, but I treat only the ones that need it, that are necessary. The ones that have hard and sulfated plates in them are the ones that I treat.

The CHAIRMAN. In other words, you do not treat a battery that has not the hard, sulfated plates?

Mr. HARRELL. In my repair work.

The CHAIRMAN. You do not?

Mr. HARRELL. Yes; I do in my repair work.

The CHAIRMAN. Let us get this straight. Do you treat a battery where you know that the plates are hard from sulfation, and you know that if you send that battery out it will come right back?

Mr. HARRELL. Yes, I do.

The CHAIRMAN. You treat that battery?

Mr. HARRELL. Yes, sir.

The CHAIRMAN. If you get a battery that is in fairly good condition, and you do not anticipate any trouble immediately, then you send that out without treating it?

Mr. HARRELL. I do.

The CHAIRMAN. Because you do not expect that you will get it returned right away?

Mr. HARRELL. That is right.

The CHAIRMAN. And your only concern is to get it in the hands of the dealer long enough to get rid of the second-hand car?

Mr. HARRELL. I guarantee the battery as long as he guarantees the car.

The CHAIRMAN. And both of you are only interested in getting it into the hands of the purchaser?

Mr. HARRELL. That is right.

The CHAIRMAN. Then, after that, neither one of you has too much concern?

Mr. HARRELL. If he guarantees the car for 6 months, I stand behind the battery for 6 months.

The CHAIRMAN. I see. But if you get a battery that is in poor condition and you know it is not going to go out and do anything, that is the one you put the AD–X2 in?

Mr. HARRELL. Yes, sir.

The CHAIRMAN. In order to break down the sulfation?

Mr. HARRELL. That is right.

The CHAIRMAN. Do you have to tear that battery to pieces in order to get that reading on the plate—to determine whether that plate is too highly sulfated to go out and do a job or not?

Mr. HARRELL. I tear all of them down.

The CHAIRMAN. You tear all batteries down?

Mr. HARRELL. All batteries that I send out like that are rebuilt or repaired; I pull them.

The CHAIRMAN. How long does it take you to pull a battery down?

Mr. HARRELL. In the afternoon—we work in a bunch—we can pull about 12 in about 2 hours in the afternoon.

The CHAIRMAN. You can pull the segments out of a battery case—you can do about 12 of them in a couple of hours?

Mr. HARRELL. Twelve in a couple of hours.

The CHAIRMAN. I see. Then you take them all——

Mr. HARRELL. We take all of them.

The CHAIRMAN. If these batteries do not show a high stage of sulfation, you just put them back together and seal them up, charge them, and they go out?

Mr. HARRELL. That is correct.

The CHAIRMAN. If you get a battery, on the other hand, that shows a very high sulfation, and you know that it is going to give you trouble, you put the AD–X2 powder in?

Mr. HARRELL. That is correct; I do.

The CHAIRMAN. Then how many batteries do you treat in the course of a month's operation?

Mr. HARRELL. I have been treating batteries now for about 18 months.

The CHAIRMAN. For about 18 months? Do you get any returns from those that are treated when they go out to the dealer?

Mr. HARRELL. At first I didn't keep records.

The CHAIRMAN. I see.

Mr. HARRELL. Because I wasn't interested in it that much. I didn't think that I was going to become involved in it at all, as I am now. I thought that, well, if you did a job it softens up the plates and everything, that is all that is necessary, and I would just let it go on out. But in June I started keeping records, June of last year.

The CHAIRMAN. June of what year?

Mr. HARRELL. June of 1952.

The CHAIRMAN. 1952?

Mr. HARRELL. Yes, sir. I started keeping records, and I started dating the batteries and stamping the cells that I treated with AD–X2.

The CHAIRMAN. And that material is so soft that you can just take a number punch and just simply punch the number right into it?

Mr. HARRELL. That is right. I have stencils, both letters and numbers.

The CHAIRMAN. So, in that way you have a positive identification, the same as a brand on an anvil?

Mr. HARRELL. I certainly do.

The CHAIRMAN. What has been your experience?

Mr. HARRELL. I have not had any of them come back yet.

The CHAIRMAN. You mean you have had no comebacks?

Mr. HARRELL. I have had no comeback since last June.

The CHAIRMAN. June of 1952?

Mr. HARRELL. That is correct.

The CHAIRMAN. Of those that you treated with the AD–X2?

Mr. HARRELL. That is right.

The CHAIRMAN. What have you had with those that were not treated with AD–X2?

Mr. HARRELL. Those that are not treated with AD–X2, I have not had a lot of comebacks. I have had some comebacks—but my comebacks, I rate them according to how I sell them, and to whom I sell them, and what I get for the battery. Some people just want a battery to trade a car in with. They want a cheap battery.

Now, you take the Good Humor Ice Cream Co., they want a battery for the season. I give them a battery and guarantee that battery for the season. If it fails during that season I replace it at no cost.

Last year I didn't get interested enough in it to make experiments with Good Humor during the season, but this year I did. I furnished them their batteries in February. They are installed in those trucks, and they get them ready around the first of March, as soon as the weather starts warming, and they put them out. Last year I didn't get into it, as I say, but this year I treated a lot of their batteries and stamped them, so when I get them back this fall when they get through with them, then I can determine——

The CHAIRMAN. Then you will get your full reading?

Mr. HARRELL. Then I can get my full reading.

The CHAIRMAN. How many batteries have you treated since a year ago when you started keeping a very close record?

Mr. HARRELL. Maybe 600 or 700.

The CHAIRMAN. Six or seven hundred?

Mr. HARRELL. Yes, sir.

The CHAIRMAN. Are you interested in Mr. Ritchie's business in any manner?

Mr. HARRELL. Absolutely not.

The CHAIRMAN. You do not sell the product to any other dealers?

Mr. HARRELL. No, sir.

The CHAIRMAN. Or any other producers?

Mr. HARRELL. I don't manufacture it. I am not a distributor. I don't sell it. I don't advertise it for sale, and never have. I am a user, a consumer.

The CHAIRMAN. You are just using it in your own shop?

Mr. HARRELL. I am using it in my own business.

The CHAIRMAN. Do you intend to continue using it?

Mr. HARRELL. I certainly do.

The CHAIRMAN. Would it be a mistake if a Government agency denied the public the right to have this product?

Mr. HARRELL. It certainly would.

The CHAIRMAN. Did Mr. Ritchie ever urge you to write a testimonial?

Mr. HARRELL. No, sir; he certainly has not.

The CHAIRMAN. He has never asked you to prepare a testimonial statement?

Mr. HARRELL. No, sir; he certainly has not. I wrote a letter to several newspapers and it was published, but Mr. Ritchie had noth-

ing to do with it. In fact, I think he was in California when I did it. I did it on my own initiative.

The CHAIRMAN. Just because of your experience?

Mr. HARRELL. Just because I wanted the facts brought out in this case that never had been brought out, and I never did see any other way for them to get out.

The CHAIRMAN. You do not care what anybody may say about the product, you yourself know what it is doing for you?

Mr. HARRELL. I know what it is.

The CHAIRMAN. And you intend to use it?

Mr. HARRELL. I know what it is doing, and I certainly intend to use it.

The CHAIRMAN. Those are the only questions I have. Do you have any questions?

Mr. HARRELL. They talk about fooling the people with it. I never have been able to fool anybody with a battery, whether it was treated with AD–X2 or not. All I have ever sold that weren't any good were either brought back to me for a refund or for another battery. I don't know how you can fool anybody with a battery.

The CHAIRMAN. No; because when a battery is dead, it is dead.

Mr. HARRELL. That is right.

The CHAIRMAN. And there is nothing deader than a dead battery.

Mr. HARRELL. I have some of the biggest accounts in this area; Good Humor is one, and they are pretty tough on batteries. I think I have the biggest account, which is Starrett Operating Service.

The CHAIRMAN. Just give us for the record the battery accounts that you have.

Mr. HARRELL. I can't give them all to you because I can't remember them all. I do have a list of them, though. The Starrett Operating Service is the biggest; they have around 475 trucks. I do all of their battery work.

The CHAIRMAN. Have you put AD–X2 in those batteries?

Mr. HARRELL. Yes, sir; I certainly have.

The CHAIRMAN. You put AD–X2 in all of those batteries?

Mr. HARRELL. Not all of them; enough to run tests on, because they have never requested AD–X2.

The CHAIRMAN. But you personally have done it?

Mr. HARRELL. I have done it.

The CHAIRMAN. You have stamped the batteries so that you can check it for a test?

Mr. HARRELL. That is right.

The CHAIRMAN. And they pay you for the services, so there is no object in your treating their batteries, because it would just lessen the amount of service that you would be giving them?

Mr. HARRELL. That is right.

The CHAIRMAN. But you have put in some and you have checked the batteries so that you can take a reading and determine whether it has AD–X2 any time you want to?

Mr. HARRELL. I can. As I said to you previously, I started testing these commercial accounts in June because at first I didn't think much of AD–X2. I never thought much of any additive. I have been test-

ing additives all my life, and had never before found any that were any good. But around September I began to keep records, and I started to put them in these various fleet accounts.

The CHAIRMAN. Who are the other accounts that you have?

Mr. HARRELL. Starrett Operating Service is one; Good Humor Ice Cream Co.; Jack & Jill Ice Cream Co.; Holmes Bakery; Alexandria Dairy. Now, on those accounts I am running tests.

The CHAIRMAN. Normally, those trucks would require a great deal of battery service?

Mr. HARRELL. They certainly do.

The CHAIRMAN. Because that is a stop from house to house, which is a start and a stop, and it is definitely hard on a battery.

Mr. HARRELL. I selected these accounts because they are hard on batteries. Starrett Operating Service rents trucks to nearly everybody; all kinds of deliveries. They have a lot of trouble. I talked with Mr. Zimmerman over there, it's been about 2 weeks ago, and he tells me that his battery bills are less, and he is having less trouble now than he has had in the last 5 years.

The CHAIRMAN. You mean in performance?

Mr. HARRELL. That is right.

The CHAIRMAN. There is not the failure in the field in these operations?

Mr. HARRELL. That is right; their service calls are not as many, and their battery bills are less.

The CHAIRMAN. Have you anything further you wish to say? We are going to try to reach the next witness before we go to lunch.

Mr. HARRELL. I think that just about covers everything.

The CHAIRMAN. Thank you.

Counsel has one question.

Mr. FORSYTHE. In your 32 years of battery experience have you ever tried any other additives or common solution of epsom salts and glauber salts, and if so, did they give the same results in your opinion as this particular product that we are discussing?

Mr. HARRELL. I have tried every battery additive that I have ever run across, and I have never found one that had any merits yet, except AD–X2.

Mr. FORSYTHE. Have you tried just plain epsom salts and glauber salts, too?

Mr. HARRELL. No, sir; I have not.

Mr. FORSYTHE. But you have tried every other additive?

Mr. HARRELL. I have tried all the other additives, every one of them.

The CHAIRMAN. Does it make any difference to you what is in it?

Mr. HARRELL. It doesn't make any difference whether it is epsom salts, glauber salts, or plain old table salt, just so it does the job and it works.

The CHAIRMAN. Thank you, sir.

The next witness is Mr. Norman Goodwin.

Do you swear that the testimony you are about to give pertaining to the matter now before this committee is the truth, the whole truth, and nothing but the truth, so help you God?

Mr. GOODWIN. I do, sir.

TESTIMONY OF NORMAN GOODWIN, PRESIDENT, GUARANTEED BATTERIES, INC., BOSTON, MASS.

The CHAIRMAN. Mr. Goodwin, we have heard your name mentioned from time to time around here in the last few days, but for the sake of the record, will you proceed to tell us who you are, what your business is, and your experience.

Mr. GOODWIN. My name is Norman Goodwin, and I am president of Guaranteed Batteries, Inc., Boston, distributors of Battery AD–X2; and Rusco Products Co., Boston, an automotive-parts jobber, which I have operated for the past 19 years. I also have been active in industry associations and societies.

The CHAIRMAN. You may be seated, if you desire, sir.

Mr. GOODWIN. Yes, sir.

Before I begin, I wish to clarify a situation about which there seems to be some doubt: that is, when batteries are treated with Battery AD–X2, there is no service work connected with these whatsoever. It is only necessary to dissolve this material into the battery electrolyte while the battery is on charge, either in or out of the equipment; it is not necessary to take the battery apart to install Battery AD–X2, and I wanted to tell you about that. There seemed to be some doubt about that.

Also, I have two pieces of evidence which I would like to see incorporated.

In view of the fact that both Senators Humphrey and Smathers have used words taken out of context from an article Jess M. Ritchie wrote in the July issue of Cars magazine, I feel it is only fair to ask the committee to place the entire story as it appears in the current issue of Cars in the record of this investigation.

The CHAIRMAN. How lengthy an article is it?

Mr. GOODWIN. It is the recent article that has just appeared.

The CHAIRMAN. Is it a page or more?

Mr. GOODWIN. Yes. Well, here is the article. Where they made reference, they have used words out of context, and if the whole article is here it could be made a part of the record.

The CHAIRMAN. It will be made a part of the record. I am trying to hold the record down so that it does not cost too much.

Mr. GOODWIN. I will leave that entirely to you, Mr. Chairman.

The CHAIRMAN. If it is not over 3 or 4 pages, why, I think the record can carry it. I am just trying to keep this record from costing too much.

(The document referred to, a reprint from the July 1953 issue of Cars, follows:)

MY BATTLE FOR BATTERY AD–X2

(By Jess M. Ritchie as told to Harry Kursh)

Scandal rocked Washington recently when the head of the National Bureau of Standards was asked to resign. Here's the exclusive behind-the-scenes story of the fight for recognition of the battery powder which caused all the trouble.

In early 1947, I moved into a dingy little shop in Oakland, Calif., in order to try to find a way to bring dead batteries back to life and extend the life expectancy of new batteries. I knew that such a discovery would be a blessing to millions of motorists and save enormous sums of money every year for American industry. The world of science and commerce would hail such a discovery and welcome me with open arms, I thought.

Well, before the year was out I found what I had been looking for and labeled it Battery AD–X2.

But instead of lavish praise, I ran into an incredible storm of violent condemnation from official and public institutions and an almost impenetrable wall of appalling scientific indifference. Before I was finally vindicated, I went broke twice, brought about sensational revelations of possible major scandals involving millions of dollars in losses to American consumers, started congressional investigations, and became the No. 1 cause for the unprecedented request for the resignation of the Director of the National Bureau of Standards, one of the most honored scientific institutions of its kind in the world.

I found myself dueling with a network of activity designed to conceal the truth about Battery AD–X2. My colleagues, the company I organized, and myself were called political string-pulling frauds by a major columnist. But I refused to take it lying down. I was only a small-business man, having never invented or discovered anything before in my life, but I rolled up my sleeves and went in swinging.

Was it all worth it?

Consider the facts. In the automotive field alone, batteries are a growing headache. Last year, an AAA survey revealed that the No. 1 road-call headache was batteries. More than 10,837,000 motorists—an all-time high—reported battery breakdowns. For servicing and restoring batteries, the Nation, according to authoritative estimates, pays a bill ranging well into the billions. I make, and can prove through scientific tests and sworn affidavits, these claims:

1. Battery AD–X2, when used to treat a new battery, will extend its normal life expectancy from 2 to 3 times. For example, if through actual experience you know that the battery in your car will have to be discarded in about 16 months, your next new battery could be made to last from 16 to 32 months longer if you treat it when new with AD–X2.

2. Even if your battery is up to 12 months old, in a hard rubber case and has not been abnormally abused, an AD–X2 treatment will give it added life.

3. If you've got a dead but mechanically sound battery—in other words, one which cannot be made to take a charge normally but is otherwise undamaged physically—you can restore it to a long and useful life with a proper AD–X2 treatment.

My introduction to the battery problem came the hard way. In the spring of 1946, I was one of the men in charge of an $80 million construction project for the United States Army Engineers in the Philippines. Working in constant heat and humidity, battery trouble on trucks and heavy equipment plagued me every inch of the way. Getting new batteries became a growing, heart-breaking problem. Yet all around me were acres and acres of brand new batteries piled on beaches that were to have been the jumping off points for the World War II assault against the Japanese mainland. After prolonged exposure to the sun, the batteries had become about as useful as flat tires. Not one of them would take a charge.

But once, years before, I had seen a fellow squeeze a lemon in a battery that was supposed to have been dead and it brought the battery back to life long enough to be of some use. I had no lemons. But I did have lots of limes and plenty of willing hands. I lined up batteries in the workshops and kept a small army of men busy squeezing lime juice into the dead batteries and with a rapid change program got enough use out of them to keep my machines going on schedule. I not only saved countless thousands of dollars in lost time, but kept Uncle Sam from getting slapped with a fat bill for new batteries.

When I came back to California early in 1947, I was only 37 but in prewar business ventures I had saved enough money to keep me comfortable for a long time. I was going to retire and concentrate on my favorite pastimes—hunting and enjoying family life with a wonderful wife and four growing children.

But I was haunted by the battery problem that had almost licked me in the Philippines. Couldn't anything be done about it? I found myself asking lots of people and reading just about anything I could get my hands on concerning lead-acid storage batteries. Everywhere I turned, I kept getting one answer—impossible. All such batteries have a normal life span, after which they break down and there's nothing you can do about it. You've got to live with it, they told me.

There's something about the word impossible that stirs me to action. I moved into a spot that used to be part of an old furniture store and went out and bought up junked batteries. Then, I set to work tearing them down, putting them together, blending, and filling them with all sorts of chemicals, charging them and

discharging them until I thought I had tried just about every trick in the books. The deeper I got into it, the harder it was for me to get out of it. One thing I learned quickly—I had a lot to learn about batteries.

One night, I was going through the encyclopedia and ran into Lewis and Randall's work on electrolytic action. A check showed that Dr. Randall still lived in Berkeley. Now, I figured I would stop knocking my head against a stone wall. Dr. Randall, it turned out, was professor emeritus of chemistry at the University of California and was widely recognized as one of the world's outstanding authorities on electrolytic action. I wrote to Dr. Randall explaining what I was trying to do.

Two weeks later, Dr. Randall called me on the telephone. We made a date to have lunch. But, we got so involved in talking about batteries that we never got around to eating and I probably never would have gotten home that night had not my wife called later to remind me that I had a home, too.

The dream of extending the useful life of batteries was an old one with Dr. Randall. He told me that he had once had some problems with lead-acid storage batteries on submarines during World War I and always hoped that some day he'd get a chance to investigate the problem. Before I left that night, Dr. Randall agreed to work as my consultant at a fee of $100 a day for every day we were together in my shop or his laboratory.

Dr. Randall dug into libraries and came up with mountains of books and literature on the subject. Meanwhile, I moved into another shop at 2411 Grove Street in Oakland, the present site of our plant. I bought close to 2,000 batteries, which we tore down to study in the shop and Dr. Randall's laboratory.

We experimented mostly with two groups of chemicals, sodium and magnesium sulfates, to which we added traces of other chemicals. We knew from past experience and scientific records that these chemicals when used as battery "dopes" or additives, would work. But only for a short time. Then the batteries would break down and become utterly worthless. We added minute traces of other chemicals to our mixtures and from April to October 1947, I often worked all night. We ran through more than 1,600 different chemical blends. On a long bench in a single row, we always had at least 56 batteries in glass-enclosed cases under observation. Behind the bench we used neon-tube lighting and in front of the bench we mounted a microscope on a rail, so that we could walk up and down inspecting any battery instantly.

One night, near exhaustion, I began processing a fresh batch of chemicals. Then I forgot all about it for 4 days. When I suddenly remembered it, I thought the chemical blend was ruined and wanted to throw it out. But Dr. Randall thought it would be a pity to waste the blend and suggested that we try it anyway. Oddly enough, the chemicals that had been accidentally processed began giving us results entirely different from anything we had used up to that point—sensational results.

We grew more tense with each passing hour and stepped up our testing. All that Dr. Randall could say was "Amazing! Amazing!" Fortunately, we had been keeping accurate notes on everything and we had exact details of that accidentally processed batch of chemicals.

Till this day, it is that process that remains the key to battery AD–X2. Instead of getting out a patent, I decided to hang onto the discovery by keeping the exact process a secret. And it is still a secret that can be found only in two places—my head, and a safety deposit vault somewhere in California.

Although some industrial batteries are enormous and cost thousands of dollars, many of us are familiar with the most common type—a little black box tightly strapped into a metal frame under the auto hood. The box is filled with a series of positive and negative lead plates and an acid-water mixture called electrolyte. When the battery is in discharge operation, the electrolyte combines with the lead plates to create electricity by chemistry.

As the electricity is used, the acid combines with the lead plates and converts the lead to lead sulfate. This dilutes the electrolyte and is the same as if you were using up the battery by pouring the acid out. But if you recharge or shoot electricity into the battery, as the generator of your auto does when the motor is turning over, you reverse the process, reconverting the lead sulfate to lead and restoring the vital acid to the electrolyte.

Thus, theoretically at least, a mechanically sound lead-acid storage battery could be used indefinitely if it were properly cared for.

Then why do storage batteries break down?

There are a number of reasons: physical damage, poor handling, and negligence. But one of the most serious causes is a chemical phenomenon known

as sulfation. Most experts estimate that sulfation dooms, either directly or indirectly, at least 70 percent of all lead-acid storage batteries in use each year.

When your battery gets sulfated, it's like getting a case of hardening of the arteries. The lead sulfate forms in the lead plates and hardens. As it continues to harden and spread, it eventually fills the lead plates with a sulfate so tough that the electrolyte cannot react with the paste in the lead plate itself to maintain the chemical process of creating electricity. Likewise, the hardened sulfate resists conversion back to lead and acid when the battery is recharged.

If half the lead plates are sulfated, it's the same as if you were using a battery half the size. You may not then get enough juice to start your car. You need a higher and more constant charge of electricity to get through the sulfated area on the lead plates to bring the battery back to its normal capacity. But when the damage from sulfation is sufficient, as is often the case, you dump your battery in the nearest garbage can.

We found that AD–X2 would not only extend the useful life of a battery by holding back sulfation, but it would also bring dead batteries back to life by attacking the sulfation, helping to restore the lead plates back to their originally soft, sponge-like state and permitting the batteries to be recharged.

Late in 1947, I began the first move in my campaign to further improve the effectiveness of AD–X2 and get it on the market. I personally went around to all sorts of companies where the cost of maintaining batteries was a major item in the operation of fleets of cars, trucks, and power equipment.

I got my first typical reaction from the battery shop foreman at the United States Army's Benicia Arsenal in California. "I've seen all kinds of battery dopes" he almost sneered. "I've been handling batteries for 28 years and I've never yet seen a dope that would work."

I then went to a colonel in the arsenal and told him what Dr. Randall and I had accomplished. We offered a deal—to give the Battery AD–X2 treatment to any batteries they would select at no cost to the Government. A lieutenant colonel accompanied me to the battery shop and treated four batteries.

They had sulfated out so badly that they couldn't possibly be recharged. One of the batteries had been on the charging line for 17 days. It wouldn't take a charge, so nobody paid any attention to it and just left it there. Normally, such a battery would have been beyond hope even with AD–X2. But all four batteries were brought back to life, including that one.

"M'boy," the battery foreman said, scratching his head, "I guess you've got something there. But how long will these batteries last?"

I had to admit I didn't know. So he put one of the treated batteries into a weapons carrier and every morning ran the battery down. He kept this up for 90 days. Then, he pulled the battery apart, inspected it and conceded that Battery AD–X2 worked. After that, the arsenal put in orders for enough AD–X2 to eventually treat 2,500 batteries that ordinarily would have ended up in the junk heap. Some of these very same batteries are still in use at this writing 5 years later.

As business continued to roll in, I made plans to organize nationwide distribution. I actually believed that the world would come begging for AD–X2.

But in the spring of 1948, strange things began to happen. By word of mouth and by letters of friends, I learned that a pamphlet called Letter Circular 302. published by the National Bureau of Standards was being widely circulated among battery users. Letter Circular 302 was actually written in 1931 and was a blanket condemnation of all battery additives. It was spread around in such a way as to give our customers and potential customers the impression that Battery AD–X2 was a phony.

We were, naturally, indignant. But we assumed an innocent mistake had been made and we wrote to the National Bureau of Standards and told them that we had developed a new and better battery additive. Contrary to the usual findings, we said, AD–X2 was obtaining amazing results and was already saving major industrial accounts huge sums of money in battery maintenance cost.

Months went by and we got no answer. Meanwhile, we were plagued by inquiries from our customers and confronted with almost insurmountable skepticism from prospective customers. We were already beginning to get an inkling that starting a new business with a revolutionary new product was a tough proposition.

There's no law that says you can't start a new business. But there are laws administered by the Federal Trade Commission and the Post Office Department that prevent you from advertising and using the mails for your product if your advertising claims are false and misleading. Whenever there is a doubt about

any product, the entire Government network relies on advice from scientists at the National Bureau of Standards. So, we could only wait for their decision.

Finally, in July 1948, we got a letter from Dr. George Wood Vinal of the Bureau of Standards. It was a strange reply, apologizing for the delay and skirting entirely the main issue in our letter.

Dr. Randall then followed this up with a new 14-page letter, in which he gave an exact description of the results being obtained with Battery AD–X2 and backing up each point with references to documented, scientific literature, except for the explanation for the lack of shedding in a treated AD–X2 battery which he could not explain. Nevertheless, he pointed out, we did not have the shedding normally expected from the salts. Surely the Bureau of Standards could not ignore the claims made by a man who had dozens of scientific papers on chemistry published by the American Chemical Society.

In his next reply, Dr. Vinal came back with the same song and dance we were to get from the National Bureau of Standards for the next 5 years—that the sodium and magnesium sulfates in AD–X2 were the same chemicals contained in hundreds of other tested additives and that for years these have never been known to work, so why bother with new tests. A letter to Dr. E. U. Condon, then Director of the National Bureau of Standards, brought a reply that simply repeated what Dr. Vinal had been saying.

Oddly enough, on top of this, when Dr. Randall submitted a scientific paper at a meeting of the American Chemical Society in California it seemed as if everyone had already formed preconceived opinions about Battery AD–X2 and the society failed to publish Dr. Randall's paper. Even, Chemical Engineering and News, official publication for the American Chemical Society, gave space to statements against all battery additives by the National Bureau of Standards virtually ignoring the work of Dr. Randall, one of their most respected members.

The scientific world crashed at Dr. Randall's feet. He became the object of bitter and virulent criticism. He was accused from all sides of writing, not a scientific report, but an advertisement for AD–X2, just because he had served as a paid consultant to me. If money and money alone affects scientists that way, how suspect must be the untold thousands of researchers who are now employed in the laboratories of big business at five-figure salaries and permitted at the same time to retain paid teaching posts with colleges and universities from coast to coast?

Then came a new blow in the form of a pamphlet called Battery Compounds and Solutions. It was published by the National Better Business Bureau in New York and was enjoying a boom circulation in the battery market. This, too, was being circulated quietly by persons who refused to identify themselves. As it turned out, the new pamphlet was nothing more than a hand-me-down of Letter Circular 302.

I couldn't understand the link between the National Bureau of Standards and the National Better Business Bureau. I was always under the impression that the better business bureau did their investigating and published the truth, without prejudice and without regard to big or little business influences. The National Better Business Bureau took the position that what was good enough for the National Bureau of Standards was good enough for them.

The position was all the more difficult to understand when we learned that on February 21, 1949, the Oakland Better Business Bureau, over the signature of General Manager Jack A. Harris, had sent out a confidential memorandum to all bureau managers.

In it Mr. Harris described how he had conducted a personal investigation and had directly interviewed not only experts, but some of our major customers, with each making a signed statement testifying to the value of AD–X2 and the accuracy of their own field tests. Mr. Harris concluded that Pioneers, Inc., was being given unfair treatment as a result of the ancient Letter Circular 302 and the inexplicable reluctance of the National Bureau of Standards to conduct an up-to-date, unbiased test of AD–X2.

With seemingly everybody lined up against us, we were getting nowhere in a hurry and losing money fast. By May 1949, I was broke and had to pay off Dr. Randall with the worthless stock in Pioneers, Inc. The fact that he was still willing to accept the stock, however, was encouraging. There were other signs of encouragement, too. Our established customers, who already included the San Francisco Port of Embarkation, stuck with us and an old friend of construction days, William H. Hager, came around and asked to get into the fight.

"You're nuts, Bill," I said. "We're going downhill. Haven't got a red cent to pay you with.

"Anything you're willing to fight this hard for and sink all your money into," said Bill earnestly, "is good enough for me." Bill joined us as an executive vice president.

Of course we had been trying all along before we went broke the first time to get independent tests by nationally recognized laboratories. This proved impossible, perhaps because the laboratories which had a reputation in the battery field were all closely tied in with the industry. By this time we had already unsuccessfully tried Government laboratories other than the NBS such as the Navy, Army Ordnance, and Signal Corps.

So, we went to our old customers who had used thousands of packages of Battery AD–X2. These included Henry Kaisers' Permanente Cement Co., as well as many other large construction and industrial outfits and a number of battery shop foremen and superintendents in Army and Navy installations. We got affidavits from them. These statements showed that Battery AD–X2 had somewhat better than doubled the life expectancy of treated batteries and had cut their battery costs in half as well as saved them from making a lot of what they considered normal battery changing for supplementary charging. These affidavits were addressed to Dr. E. U. Condon, then Director of the National Bureau of Standards, with additional copies directed to the National Better Business Bureau. But none of these affidavits were ever acknowledged in any way by the National Bureau of Standards.

In March 1950, a major calamity shook Pioneers, Inc., and all of us personally, when Dr. Randall died of a heart attack at the age of 62. It was his scientific genius that had been spearheading the fight with the Bureau of Standards and now we had lost both Dr. Randall and his invaluable help. I managed to round up enough money to buy back Dr. Randall's stock so that his estate would have cash instead of paper.

We kept going, nevertheless, by pulling one of the most sensational stunts ever attempted in the battery industry. We bought up thousands of old, useless batteries, put them through the AD–X2 treatment, and sold them as second-hand batteries with complete, 1-year money-back guaranties. Not only was this a better guaranty than the industry was offering for new batteries, but we did not prorate the guaranty, as the entire industry does when a faulty new battery is returned. We took out insurance to back us up.

We did a thriving business and plunged back into the fight to win nationwide acceptance for Battery AD–X2.

From that point on we kept up a running battle in which all our enemies seemed to rely on statements from the National Bureau of Standards for the barrage against Battery AD–X2. The battle took up most of our time and cost us more than $250,000.

Our first big break came in December 1950. It began with a visit from George A. W. Boehm, science editor of Newsweek. Mr. Boehm, a young, affable, former staff member of the American Chemical Society with an inquisitive mind, told me that back in 1948 he had met Dr. Randall at the time Dr. Randall was being criticized by the society for his support of AD–X2.

Mr. Boehm was brutally frank. He made it clear that he was after a story that would expose Pioneers, Inc. I answered all his questions as best I could and opened my files to him. He made a note of the name of every major customer. Then he went around and did his own investigating.

On December 11, 1950, he reported facts that were highly favorable to AD–X2, referring to his interviews with such men as Alexis I. Mei, dean of arts and sciences at the University of San Francisco, where practically useless batteries in the physics department had been restored with AD–X2.

This was the break we had been waiting for. The day after his report appeared, my office phone didn't stop ringing for a moment. We were flooded with requests for information and samples from businessmen all over the country. I got out of a sick bed (having had 24 teeth extracted the previous day) to man the phone. Soon we had received more than 8,000 letters from just about every State in the Union.

Apparently, however, it opened more than one pair of eyes. In less than a month the Bureau of Standards was out with a new revised circular on battery additives. This one was under the joint authorship of Dr. George Wood Vinal and Mr. Paul L. Howard and was officially listed as Letter Circular 504. It was another sweeping condemnation of all battery additives, claiming that it was based on new tests but left people in the dark as to whether it included an actual test on Battery AD–X2. The Bureau of Standards, as will be shown later, many times implied that AD–X2 was included in their tests mentioned in Letter Circular 504.

Although the chemical analysis of the materials reported on in Letter Circular 504 were all different from each other, none of the chemicals tested agreed with the known analysis of Battery AD–X2. This is very interesting, since it was later claimed that two of the batteries tested were treated with Battery AD–X2. Yet the analyses showed that no 2 chemicals used in the test batteries in Letter Circular 504 were alike.

Had it not been for this circular, I would have been sitting pretty. The year 1951 ended with my business showing a 4,000 percent increase over 1950 and a national distributing system set up throughout most of the United States and eastern Canada.

But by the beginning of 1952, business began dropping off to the level of 1949, when I was only getting started—just too much National Bureau of Standards and National Better Business Bureau for us. Once again we were going broke.

After Dr. Allen V. Astin took over as Director of the National Bureau of Standards, I wrote him pointing out that there had been three statements given out concerning Letter Circular 504, condemning all battery additives, and that these releases together with Battery Compounds and Solutions circulated by the National Better Business Bureau, quoting the National Bureau of Standards and condemning our product by name, were ruining our business. Inasmuch as Dr. Astin was the new Director, we thought that he would change this unfair situation. He replied to the effect that there had actually been four releases of this nature and that they had been caused by our own activities. He further stated "we would like to stress again that it is the established policy of the National Bureau of Standards neither to approve nor condemn any specific proprietary product." This was on January 21, 1952.

Early in 1952 I was hit with a post office notice that hearings of fraud charges against us were going to get under way. I knew this had to be my last-ditch stand against Washington. So, I flew there with my wife and we set up battle headquarters in a 3-room furnished flat, where we unloaded all our files, documents, scientific testimony, and sworn affidavits from AD–X2 users.

We did what any citizen with a grievance would do. With my distributors behind me, we wrote to Members of Congress. We asked for only one thing—a complete investigation of prejudice at the National Bureau of Standards and a fair test of AD–X2.

Enough pressure was put on Dr. Astin to get what we thought would be a clearcut test of AD–X2. I insisted that it be tested atccording to the same standards by which it had been tested by other scientists. If AD–X2 failed then, I would concede defeat. No product can succeed unless it offers honest value and I knew we were giving honest value or the same people would not have been giving us repeat business year after year.

The test was run. But the Bureau of Standards refused, except in 1 or 2 minor instances, to permit me to observe. In fact, they altered 10 of the test conditions and went ahead in violation of the agreement to follow my conditions. As I expected, the results were unfavorable to AD–X2 and they were publicized by the National Bureau of Standards as though I had actually approved all conditions for the test. Our test procedure was, and is, no more than good battery practice.

Another very interesting thing about this test was that the National Bureau of Standards admitted 30 mathematical errors in the report although the report only consisted of 27 pages of double-spaced mimeographed sheets.

Fortunately, it didn't end there. The Senate Small Business Committee, then under the chairmanship of Senator John Sparkman, got its hands on the controversy and decided to end it once and for all.

Senator Sparkman requested Maj. Gen. J. A. Lester, commanding officer of the San Francisco port of embarkation in California to report to him the results of the base's experience with AD–X2 treatment of 158 marine batteries. On September 28, 1952, in answering a list of 12 questions submitted by Senator Sparkman, General Lester reported that as of then, 72 percent of the batteries treated with AD–X2 were still in service or stored in a serviceable condition." The other 28 percent had been removed from seervice due to "operation failure," but there were no known failures of treated batteries due to sulfation. The treatments had been made in 1949.

The committee further determined from the National Bureau of Standards, the National Better Business Bureau in New York City, and the Oakland and San Francisco Better Business Bureaus (we had been selling the product in both of the latter cities all these years) that none of these agencies had ever received a complaint from a user of the product.

Then the Senate committee moved with dispatch and requested an unprecedented independent test under the supervision of the world-renowned Massachusetts Institute of Technology.

I knew this was going to be the final shot in the war over AD–X2. No private institution enjoys a more revered reputation for unbiased scientific honesty. MIT agreed, at the request of the Senate committee, to conduct the tests as a public service and at no cost whatsoever to the Government.

On September 29, 1952, a meeting was held at the Nattional Bureau of Standards, at which Dr. Astin agreed that the Bureau could participate in a test outside of the Bureau and that he would like to see such a test run with National Bureau of Standards personnel participating. As it was suggested that this might be done at Massachusetts Institute of Technology, he agreed that the Bureau would furnish that institution the number of batteries to be tested which would satisfy the Bureau.

Later the National Bureau of Standards failed to do this and when they were notified by the Senate Small Business Committee that the test was ready to go at MIT, the Bureau refused to participate—without any explanation. So the test went on.

The MIT tests themselves were carried out by Dr. Harold C. Weber, D. Sc., professor of chemical engineering, author of Thermodynamics for Chemical Engineers. Dr. James A. Beattie, Ph. D., professor of physical chemistry at MIT, coauthor of Beattie-Bridgman Equation, collaborated with Dr. Weber on a portion of the tests. Statistical analysis on the test were done by Prof. Proctor Wadsworth, mathematics department of MIT, assisted by Dr. James G. Bryan, Ph. D.

The findings in regard to Battery AD–X2 in these tests were briefly as follows: 1. Higher capacity. 2. Decrease in sediment (less battery mud). 3. Gas passed in finer bubbles. 4. Softer negative plates. 5. Less water used. 6. Lower temperatures. 7. Higher hydrometer readings (the increase being greater than could be attributed to treating material added). 8. Higher conductivity of electrolyte.

Since the MIT tests were run to establish facts only, no conclusions were given by MIT on the results of the test. Dr. Keith J. Laidler of Catholic University, a man who had once been retained by Pioneers, Inc., in the spring of 1952 as a consultant, and who was now working for the Senate committee as consultant without pay, was asked by the committee to evaluate the documented evidence which the Senate committee's investigation had compiled on the product. This included 8 controlled tests, 6 uncontrolled tests, many sworn affidavits and letters of testimony covering the use of thousands of treatment packages of the product over a 5-year period. The MIT tests were included in this material.

Dr. Laidler's conclusion, after evaluating this mass of evidence, was "they demonstrate beyond reasonable doubt that this material [AD–X2] is in fact valuable, and give complete support to the claim of the manufacturer. They also show additional desirable effects not specifically claimed by the manufacturer."

On the morning of December 18, 1952, the Senate committee released its report in a detailed 5,000-word document which vindicated us completely.

How could the Bureau of Standards have been so wrong?

In his concluding remarks on the Senate report, Dr. Laidler covered the question this way:

"Our present concern is how the Bureau could dare to make such grave errors. Several of the Bureau staff working on the tests are men of considerable scientific distinction. All are experienced with batteries. Vinal and Howard, indeed, the authors of Circular 504, have now left the Bureau and are employed by battery companies. It seems to the writer to be possible that it is this very close association with batteries that has made these workers suspicious of new advances in the field.

"When one has worked for many years with the same type of equipment one comes to think that no improvements in it are possible. We all have a strong streak of conservatism and resist any change. These scientists had worked with batteries for so long that the possibility of any improvement in them was inconceivable. They, themselves, in fact, would have thought of any improvements if any were possible. How preposterous that Ritchie, not even a scientist, let alone a Ph. D., could develop anything that the pundits had not thought of before!"

The Bureau of Standards was given a copy of the MIT tests. Then on February 10, 1953, in a 17-page epistle, they reached two momentous conclusions: 1. They could duplicate part of the MIT tests with the same results. 2. The MIT tests had nothing to do with the normal operation of a battery.

Boy—that did it!

For 5 years the Bureau had been telling us that if the material was doing so much good in battery operations it should at least be able to show some effect in

a laboratory test. Now they were saying in effect that they would not accept field tests because they were not run in the laboratory and they wouldn't accept laboratory tests because they were not run in the field.

Meantime, Sinclair Weeks had been appointed Secretary of Commerce. Here occurred one of the quirks which helps the little man to realize that God never really forgets him. Mr. Weeks had formerly been on the board of directors for both the United Carr Fastener Corp., and Gillette Safety Razor Co. in Boston. About a year and a half prior to this time, our distributor in Boston had convinced both these outfits to try our product. Both organizations were now steady users of Battery AD–X2. In fact, Weeks later stated that one of these companies had treated with Battery AD–X2 a $1,350 industrial battery which would no longer function and that the battery was still working 13 months later.

A number of our distributors found out about this and started writing to various officials in Washington. We realized that the National Bureau of Standards was still all powerful but we thought that by bringing the situation to the attention of the new administration, the matter would shortly be completely resolved. What we didn't know was that the letters which were being written to the top officials were not being seen by them at all. In the meantime, I sat waiting in Washington for the good word.

I got the word—and there was nothing good about it!

Bill Hager, our vice president, called from Oakland, Calif. "Jess," he said frantically, "we're in trouble. I just got word from the Postmaster General that all our incoming mail will be stamped fraudulent and returned to the sender. This goes into effect immediately—we're ruined."

"Not so fast, Bill," I shot back, "this is the last straw. Remember, the harder you're hit, the harder you have a right to hit back."

In the rush of things, I had neglected to keep up with an earlier Post Office hearing and we had been found guilty by default. Later, we filed a correction of default and two applications to reopen the case.

When Bill called me, they had thrown out our application for correction of default, refused both of our applications to reopen the case and issued the fraud order, effective immediately. So, you can see what Bill meant when he said, "We're ruined."

I hung up the phone after talking to Bill, grabbed my wife, who is also my secretary, and really got going.

The first move was to see Mr. Blake O'Connor, staff member of the Senate Small Business Committee. He recognized the situation as a grave one and contacted Senator Edward J. Thye, the new chairman of the committee. Senator Thye went on a standby basis and I contacted an attorney—Kahl K. Spriggs, of the law firm of Ellis, Houghton & Ellis. I have never in my life seen any man catch on to a technical problem as quickly as Kahl Spriggs. With both of us dictating to the same secretary, in 2 hours' time we turned out a memo to the Postmaster General in which Mr. Spriggs pointed out that by no stretch of the imagination, in his opinion, could our case be considered a matter for a fraud action by the Postmaster General. My wife and I then left for Senator Thye's office with the document. In the meantime, Senator Thye had written a letter to go with the document pointing out that the situation was a ruinous one for us.

Blake O'Connor, who had been waiting with Senator Thye, delivered the two documents late Friday night, February 27, to Postmaster General Summerfield at his home on Connecticut Avenue. It was the beginning of a mad scramble which ended Monday night, March 2, with the Postmaster General suspending indefinitely the fraud order. This was done at the written request of the Secretary of Commerce and concurred in by the Attorney General.

Our mail was delivered that afternoon by special carrier. Every piece of it had been stamped "fraudulent." But due to the action outlined above not a single piece of mail had been returned to the sender.

By this time things were beginning to roll. At last top officials recognized the situation. In short order, Dr. Allen V. Astin was asked to submit his resignation. He did but was later asked to remain in his job temporarily.

On March 31, before the Senate Small Business Committee, Secretary of Commerce Weeks explained that his key reason for dissatisfaction with Dr. Astin was the handling of the Battery AD–X2 case by the Bureau of Standards. The Secretary further testified that the "manufacturer had had independent tests made (of Battery AD–X2) by the United States Testing Co., of Hoboken, N. J., controlled field tests extending over a period of 362 days. These tests rendered credible the experience reported by consumers. * * *

"* * * the National Bureau of Standards has not been sufficiently objective because they discounted entirely the play of the market place and have placed

themselves in a vulnerable position by discussing the nature and scope of the prospective reports with the very people who might not want to see the additive remain on the market."

Secretary Weeks has been criticized on the basis that his method of action was motivated by political reasons. But Dr. Astin, like Secretary Weeks, is a registered Republican; also, Secretary Weeks has been attacked because he is a businessman and not a scientist—but I happen to know that he had the counsel of the best scientific brains prior to taking his action. Finally, Mr. Weeks has been criticized for not having the interest of the consumer at heart. But, after all, Battery AD–X2 can be expected to save the average car owner a minimum of $20 for an investment of only $3.

I still don't know whether or not I face clear sailing ahead. As of this writing it looks like there may be plenty of fireworks coming up. But I am sure that I will now get a square shake from Washington and that the true facts will be open for the American car public to see and interpret. I still wonder how many other small-business men, especially those eager to introduce new products to the American people, have been buried under an avalanche of Government bureaucracy and official innuendo.

But this much I do hope: I am going to be able to set up my California business in a nationwide scale and bring to the motoring public, industry, and Government the most revolutionary money saving improvement in many decades.

However, my deepest satisfaction will not be a financial one. I'm proud to have been able to pioneer a trail over which many other small-business men may now follow against what once seemed to be insurmountable odds.

Take a small hammer to a big rock and it makes no difference how big the nick or how small the hammer—just pound long enough in the right place and the rock will break. But be sure you've got the truth on your side.

Mr. GOODWIN. I have a letter from the Department of the Navy which is addressed to me, dated April 5, 1951, informing me that the Bureau of Aeronautics of the Navy could not use Battery AD–X2 because of Circular 504, which they sent to me.

The CHAIRMAN. How much business had you had with the Bureau of Aeronautics before?

Mr. GOODWIN. I hadn't had any.

The CHAIRMAN. You had none, but you were trying to sell them?

Mr. GOODWIN. I was trying to sell them.

The CHAIRMAN. You were trying to sell them an order and they said because of the bulletin put out by the Bureau of Standards they could not buy?

Mr. GOODWIN. If you would care to, I would like to have that included.

The CHAIRMAN. You may read it into the record.

Mr. GOODWIN. Here it is:

DEPARTMENT OF THE NAVY,
BUREAU OF AERONAUTICS,
Washington, D. C., April 5, 1951.

GUARANTEED BATTERIES, INC.,
75 North Beacon Street., Watertown, Mass.

GENTLEMEN: Your letter of March 15, 1951, stated that your company supplied AD–X2, manufactured by Pioneers, Inc.

The attached pamphlet,[1] published by the National Bureau of Standards, furnishes evidence that battery additives are of no practical value to the battery. Similar tests and results have been experienced by the Bureau of Ships and the Signal Corps.

As a result of these tests, AD–X2 is not permitted in any batteries installed in naval aircraft.

Sincerely yours,

E. C. BEST, *Colonel, USMC,*
Deputy Director, Electrical Division,
By Direction of the Chief of Bureau.

[1] National Bureau of Standards Circular 504, referred to, appears elsewhere in the record, p. 518.

The CHAIRMAN. But, of course, you have attached to that letter that bulletin of the Bureau of Standards and, of course, that document (National Bureau of Standards Circular 504) is already in the record.

Mr. GOODWIN. Now, if I may be permitted, I would like to read my testimony.

The CHAIRMAN. You are permitted to proceed in any manner that you wish.

Mr. GOODWIN. Before taking over the distribution of the AD–X2 in the New England area, I flew to Oakland, Calif., and thoroughly investigated Battery AD–X2, calling on several large users, who were enthusiastic.

I also called on Battery AD–X2 competitors and found out how they feared that AD–X2 would cut down their battery business.

In the belief that I could establish a business which would render a most beneficial service to the battery-using public, I purchased $13,200 worth of AD–X2 for cash, formed Guaranteed Batteries, Inc., a Massachusetts corporation, and then the roof fell in when we started to feel the effects of the Bureau of Standards Circular 504 denouncing all battery additives as being worthless, which was issued just about that time.

I got into this picture just at the time when our competition started to circularize this Circular 504 in quantity.

The CHAIRMAN. Who was your competition?

Mr. GOODWIN. The battery manufacturers, the manufacturers and dealers or people who were selling batteries.

The circular appeared miraculously from nowhere, and it was shown by all our competitors, which you will see as the testimony goes.

I got into this picture just at the time when our competition started to circularize this Circular 504 in quantity. No matter how we tried to sell our product we were always confronted with these circulars which damned our product, along with all the other battery additives, as being spurious and of no value.

To date, I personally, Guaranteed Batteries, Inc., and Rusco Products Co., which is the automotive-parts company that I am connected with, have lost in the past 2½ years in excess of $40,000.

This loss is comprised of actual cash loss, in addition to actual loss of business suffered by Rusco Products Co., because of loss of my services.

This is an extremely conservative estimate. In addition, we had five subdistributors located in New Bedford, Hartford, Worcester, Lynn, and Quincy, Mass.

The amount of their losses, both in actual cash and loss of income were they in other employment, is probably greater than our loss. These subdistributors are all now out of business; they just couldn't make out against this overwhelmingly unfair competition which had been directly caused by the United States Bureau of Standards which issued Circular 504 condemning all battery additives.

The CHAIRMAN. Mr. Goodwin, did you have a period where you were selling the product before the circular came out?

Mr. GOODWIN. No; the circular came out—the date is on the circular here—January 10, 1951. That was just the time our corporation was being formed.

The CHAIRMAN. Well, the reason I asked the question, in order that this record may be absolutely clear, I wondered whether you based your loss on some previous figures or whether you based your loss on the anticipated business?

Mr. GOODWIN. No. The breakdown in the loss is $28,000 cash, and $12,000 by Rusco Products Co.

The CHAIRMAN. How did you figure that loss if you did not have a history that you could refer back to?

Mr. GOODWIN. Well, we had a corporation. Our corporation was capitalized, and with capital paid in and loans, made at the time a total of $31,500. Of that amount right now I doubt if the net assets of the company are over $5,000. That I call a cash loss.

The CHAIRMAN. You had anticipated a business that never materialized?

Mr. GOODWIN. That is very definitely so.

The CHAIRMAN. I am having a little difficulty myself in determining what you lost, and I want to be fair.

Mr. GOODWIN. That is right.

The CHAIRMAN. If the other members of the committee were here they could ask you those questions.

Mr. GOODWIN. You go right ahead.

The CHAIRMAN. But they are not here. In order to make the record clear, you had no history of business sales?

Mr. GOODWIN. No, that is right.

The CHAIRMAN. Then, all you are basing your loss on is the business that you had anticipated.

Mr. GOODWIN. No, sir; that is not right.

The CHAIRMAN. That is what I want to get clear in the record. How do you figure your loss and on what do you base it?

Mr. GOODWIN. The actual amount of money that has been spent to keep the corporation in existence in the past 2½ years plus additional money that has been supplied by Rusco Products when they had to pay my salary when Guaranteed Batteries was not able to pay it, plus a lot of business I would have gotten for Rusco, business in the automotive-parts business had my services been toward getting that business.

The CHAIRMAN. Toward making sales of the compound?

Mr. GOODWIN. No. You see, I have an automotive-parts jobbing business, Rusco Products Co., and, of course, my services from that company have been entirely disconnected because when we formed this Guaranteed Batteries I was president of that company, and my entire services were claimed by that company. Therefore, my other business naturally suffered a loss from business which I would have brought in. When I mentioned $12,000 that is extremely conservative.

The CHAIRMAN. If you were permitted—if you did not have this bulletin out condemning the product—you know that you could go into a business establishment and say, "I can guarantee you an extended life of your battery if you permit me to treat it," is that what you say?

Mr. GOODWIN. Well, I could do that, yes; and I could talk to the person and he would buy the material if it was just on a competitive basis like anything else, like he would buy clutch facings, brakes, or anything else in the automotive business, you see. But when this Circular 504, put out by the Bureau of Standards says that it is ab-

solutely of no use, and every one of your competitors is passing that out——

The CHAIRMAN. You could not sell a brake lining if the Bureau of Standards put out a pamphlet that described your brake lining as being absolutely worthless.

Mr. GOODWIN. That is very definitely the case.

The CHAIRMAN. The same applies to the compound——

Mr. GOODWIN. That is right.

The CHAIRMAN. With that positive statement of the Bureau of Standards; it just forecloses any opportunity of your sales organization going into the field and selling the product.

Mr. GOODWIN. That is right.

The CHAIRMAN. That is where you get your loss from?

Mr. GOODWIN. That is so.

The CHAIRMAN. Now, then, you have made some sales, though?

Mr. GOODWIN. Yes. I am very pleased to feel that I have been able to make sales in spite of this opposition.

The CHAIRMAN. Those sales were made in what manner?

Mr. GOODWIN. By my efforts to go out and interest these people. My testimony as I go along will tell it.

The CHAIRMAN. All right, proceed with your testimony.

Mr. GOODWIN. This is an untenable situation when a governmental bureau which is in being for the benefit of the country and its citizens, sets itself up as a tribunal to condemn products in a sweeping manner, and because of the influence and prestige of this Bureau, new products are suppressed and material aid given to the new product's competitors.

Battery additives have, in the past, had an unsavory reputation, and with cause, because up to the time Battery AD–X2 entered the picture, I have no knowledge of a successful battery additive. One wonders, that, should there actually have been one, it could never have survived this unfair competition, and so withered on the vine.

However, in this day of scientific progress, is it too much to expect that battery chemistry can be improved? The Bureau of Standards would have us believe that such is the case.

In view of the actual field experience with Battery AD–X2, which has been piled up in all parts of the country, it is absurd that the Bureau of Standards, with their inadequate laboratory tests, would even dare to ignore the excellent results obtained from the wealth of field experience over a period of years, results which have saved large and small companies many hundreds of dollars, and demonstrated its value to increase both the efficiency and longevity of lead-acid batteries.

Scientists and scientific institutions agree that final results are obtained in the field, and that when laboratory experiments corroborate these field results they are of value.

With the adamant position which the Bureau of Standards has maintained all along, dismissing field experience as of no value, one is lead to wonder just what might be in back of it all; just what has been the reason. In the light of the above, the Bureau's position is untenable, and should stand investigation.

Now, industrial batteries represent large investments, some running into thousands of dollars, and are usually in the hands of capable engineers. Most of these engineers realize that battery life and

efficiency could stand considerable improvement, and many would like to use AD–X2. But, let us examine their position in the light of the Bureau of Standards' attitude, the distribution of their Circular 504, and the fact that the battery manufacturers use this as a basis for voiding all guaranties on batteries they would treat with AD–X2.

The CHAIRMAN. You mean therein lies the danger that the manufacturers just simply say, "We will not guarantee the battery if we find AD–X2 compound in the solution of the battery"?

Mr. GOODWIN. That is true, sir.

Usually, after we have discussed AD–X2, the engineer will contact the battery manufacturer for further information and guidance. What could be more natural? The manufacturer usually does not talk against AD–X2. He just tells him the United States Bureau of Standards does not approve of battery additives, and then shows him the 504 circular, and informs him his guaranty will be voided. That is the grandest, most positive, and sure-fire salesman the battery manufacturers could ever have, and gives us the worst kick in the face we could ever receive.

At this point, usually all possibility of AD–X2 business just vanishes, a situation which is hard to conceive of.

Consider well this engineer's position. AD–X2 may be everything we claim, but if he doesn't use it, he has nothing to lose, his job and his reputation are safe. However, should he use AD–X2 and it doesn't work out as expected, he could lose his job and also lose face, both of which could affect his earning capacity.

Naturally, most men, when confronted with this choice, do 1 of 2 things: They either refuse to do anything at all or they dig out an old battery that is absolutely worthless, one that would not respond to treatment with AD–X2. A battery has to be in a mechanically sound condition to benefit from AD–X2 treatment; that is definite.

The CHAIRMAN. Do you have to tear a battery down for the purpose of getting the best results out of AD–X2?

Mr. GOODWIN. In treating a battery, if a battery is mechanically sound, you treat the battery without taking it down. If a battery is not mechanically sound, and you still want to try to salvage that battery, then the only recourse you have is to take that battery apart and examine the parts, the plates, the separators, and find out if that battery could be reclaimed by putting new separators in or by using the old plates or by any one of the various means that are used to reclaim batteries.

The CHAIRMAN. But normally if a battery is just sulfated, there is no need to do any mechanical work on the battery.

Mr. GOODWIN. Absolutely no need whatsoever.

The CHAIRMAN. Only an application of the powder?

Mr. GOODWIN. And normal use of the battery after that charging, and put in use.

The CHAIRMAN. So that you are not selling a service, you are only selling the compound?

Mr. GOODWIN. That is right.

The CHAIRMAN. You do not service the battery in any manner excepting the addition to the battery cell of the compound?

Mr. GOODWIN. At the present time we are not doing that. We did do that, but we didn't find it economical, an economical method of doing business.

The CHAIRMAN. What was that; bring the batteries in?

Mr. GOODWIN. Bring batteries in, tear them apart, rebuild batteries, and so forth.

The CHAIRMAN. You just put the testers on just to make certain there are no shorts in any of the cells?

Mr. GOODWIN. Of course, I must say at this point that there is a possibility of a battery not being mechanically sound and not showing up in tests. But when you have had a certain amount of battery experience which is gained through coming into contact with batteries, and you find out the history of the battery and see just how it is being used and the visual indications that you can see, you usually are in a position to determine whether money should be spent to salvage that battery, to treat that battery.

The mere fact that the Bureau of Standards says that a product is of no use, actually constitutes a death sentence for that product—a tremendous power for any bureau to have.

Those engineers who have more courage will treat one battery as an experiment; then comes the long, long waiting period to see how it works. We just get experimented and tested right out of business. Practically each and every concern is a new, individual deal which has to be started from scratch, and followed through with painstaking care.

Even after successful tests, when everything seems to be working out fine, additional resistance is encountered from other departments within the organization, sometimes in other parts of the country. We just are doomed to failure unless the unfair competition created by a Government bureau is gotten rid of, and the right of free, unfettered, competitive enterprise is allowed to function in the true American way.

This matter is serious and strikes at the foundation of free enterprise. In our case, free enterprise has meant the freedom to go broke.

Until recently, we were not in the good graces of the National Better Business Bureau, and even our reputations as reputable businessmen were affected. Can you imagine my personal reputation being controlled by the actions of the United States Bureau of Standards? You will agree that this is altogether too much power for a Bureau of Standards to have, and it is time their halo was removed.

Because of the Bureau of Standards' actions regarding Battery AD–X2, the Armed Forces of this country, who are attempting to spend the taxpayers' money efficiently, have been and are being denied the use of this remarkable product. Here and there we have sold relatively small quantities of AD–X2 to military bases and facilities, only to have restrictions placed on further purchases of this product, even though beneficial results have been obtained.

This administration is making a strenuous effort to cut expenses, yet, because of the United States Bureau of Standards, the waste of batteries in the United States Armed Forces is tremendous. Because, of necessity, their batteries are usually shipped dry; that is, with no electrolyte. These batteries are supposed to last indefinitely in this condition, but, of course, they do not.

Every Armed Force base will tell you the same story: Their battery problems are among the most miserable items of maintenance that they have to contend with. Let me repeat that: Every Armed Force base will tell you the same story: Their battery problems are among the most miserable items of maintenance that they have to contend with.

A great many times new batteries will not even take a charge, and are returned to the stock department, after which they are sold for junk. AD–X2 would save 90 to 95 percent of all of these batteries, and this, in itself, would represent a tremendous saving.

Also because military vehicles are subject to standing around idle for indefinite periods, the batteries become so sulfated they cannot be used. AD–X2 would remedy this situation, thereby saving untold amounts of money that could be used elsewhere.

In addition, the efficiency of the military vehicles would be increased tremendously, and the safety of both our men and equipment in the field of battle insured to a much greater degree. Battery dependability in our military vehicles is a "must."

I have talked to military men in charge of vehicle maintenance, and they would give anything to be able to use AD–X2 to get away from battery troubles. To give you an idea of battery costs to the United States Government, the 24-volt system which is now being standardized on military vehicles, requires two 12-volt batteries, each costing the Government $60, a total of $120 per unit, per vehicle.

There are also larger tank batteries. The batteries in one submarine cost in the neighborhood of a quarter of a million dollars. Batteries are a large item of expense, and AD–X2 presents the Armed Forces with the opportunity to cut battery costs tremendously and also to increase battery and military vehicle efficiency.

Anyone who makes a sincere attempt to inquire into battery operations at military installations will easily be able to check on the accuracy of the above information.

In December 1951, I gave a talk on AD–X2 at the annual meeting of the International Municipal Signalmen's Association in the Hotel Puritan, Boston. I was allowed 30 minutes for questions.

The New England manager of a large national battery manufacturer stood up, and he and his assistant took up the whole question period reading the Bureau of Standards 504 circular, and otherwise fouling up the situation. Why? What had they to be afraid of if AD–X2 was no good? It would be hard for me to believe that his reasons were purely altruistic. They had their place on the program the following day.

This is indicative of the type of competition we experience. I might say here that I treated fire-alarm batteries for the city of Somerville and the city of Waltham, Mass., approximately 18 months ago, and they are functioning excellently, even though the batteries in Somerville were in a deteriorated condition at the time. The importance of fire-alarm batteries cannot be overemphasized.

Regarding field tests: What would you say if you were in the position of Market Forge Co. in Everett, Mass.? This is a little repetitious, but it is in here, and I will read it. They had an industrial truck battery approximately 4½ years old which they had not been able to charge or use for a period of 12 months. The electrolyte was way down in the cells, and as far as they were concerned the bat-

tery was junk—in fact, negotiations had been made with the manufacturer to buy it for $29, the junk price.

In view of AD–X2 instructions to treat only mechanically sound batteries, I gambled and treated this battery on an if-and-when basis. This battery came back to full power and is still doing a full day's work.

The CHAIRMAN. How long a time is it since you treated the battery?

Mr. GOODWIN. This was over 15 months ago—I think it is nearer 17, but it is definitely over 15. You see, in this particular case I didn't bill the battery until after I had the permission of the concern to make a billing, and I am sure that it was 3 months prior to that, but I billed that battery, billed this concern for this battery 15 months ago.

How could the Bureau of Standards explain this in the light of their findings?

The Boston Army Base was in a bad fix. The 108-cell fire-alarm battery had given out because the sediment in the cell bottoms had reached the plates and short-circuited the plates. New batteries had been ordered for the past 6 months, but had not arrived.

The master electrician jounced the cells a little—he got the cells and jounced them—to lower the sediment away from the plates.

After this was done the battery wouldn't take and hold a charge. The management was desperate; the batteries had to function, so they gambled on treating with AD–X2.

This was not done with any guaranties or assurances from me, as the whole thing looked hopeless.

However, the batteries responded to the treatment.

The CHAIRMAN. What was the cost involved in those batteries, if they had to be replaced?

Mr. GOODWIN. I don't remember, but it cost $288 to treat those batteries. It was a large-sized battery setup. The batteries are 36, and that tall and that deep [indicating], glass batteries, and the rest of them were smaller batteries. They are a very fine battery. I really haven't any idea of the cost, but you can probably figure 8 or 9 times the cost of the treatment. However, if you were to get in touch with the engineering department of the Boston Army Base they would substantiate my statement.

However, the batteries responded to the treatment. That was February 14, 1952. The new batteries arrived in March, but since these old batteries were now functioning O. K., and a lot of work had to be done on the entire fire-alarm system, the new batteries were not installed until either August or September of that year. You may be sure these people do not concur with the Bureau of Standards findings. AD–X2 in this instance was a godsend.

Also General Electric Co.'s River Works, in Lynn, treated 12 cells of a 48-cell fire-alarm system. These were all working together in series. In the cells treated—when I say they were in series, I mean one was connected right to the other, all doing the same work, receiving the same charge. In the cells treated:

(1) The plates cleaned up nicely; the plates in the other 36 cells remained dirty-looking.

(2) The gassing was in the form of small, fine bubbles, instead of the large bubbles which were evident in the other cells.

(3) The water level, after 6 months, was much higher than in the other 36 cells. No water had been put in purposely to determine that.

(4) The voltage across these 12 cells after 6 months was 3 volts greater than across any of the other three 12-cell groups.

(5) The current was steadier in the treated cells.

This was definitely a controlled test, as all 48 cells received the same treatment; they were all in series. These cells have now been treated for over 11 months.

At the same time, July 9, 1952, they treated a 340-ampere, $1,100 industrial truck battery that was 8 years old and wouldn't take a charge. This was, to them, a junk battery.

This battery was treated as an experiment, and after the first 3 days has worked a full day every other day since.

The CHAIRMAN. When you say an industrial-truck battery, you mean the large batteries?

Mr. GOODWIN. They are these large batteries that operate trucks in the building. Their entire power comes from it to motivate that truck—comes from the battery.

The CHAIRMAN. And those are how expensive?

Mr. GOODWIN. This one was $1,100.

This battery was treated as an experiment. At that time I didn't wish to treat the battery, but they told me to go ahead and treat it. If it didn't work they would still pay me, but if it didn't work they would take it apart and find out what had happened.

This battery was treated as an experiment, and after the first 3 days has worked a full day every other day since. They are amazed.

I figure the Bureau would also have difficulty explaining this one. This battery actually would not take a charge; it wouldn't even take a charge, and was considered junk; in fact, it was taken from the junk pile.

The CHAIRMAN. Did you do any mechanical work on that battery before you applied the AD–X2?

Mr. GOODWIN. Yes. In fact, three lead-connecting straps had already been removed and had to be replaced before we could treat the battery.

The CHAIRMAN. I mean, did you pull the cells out?

Mr. GOODWIN. No.

The CHAIRMAN. All you did was to connect those connecting links on top?

Mr. GOODWIN. Yes, the straps. We had to do that in order to be able to charge the battery.

The CHAIRMAN. But you did not pull the battery cells out?

Mr. GOODWIN. No.

The CHAIRMAN. So there was no mechanical work done in the separators or the plates?

Mr. GOODWIN. Nothing whatsoever.

The CHAIRMAN. You did not dump the solution out?

Mr. GOODWIN. No. We just added the AD–X2 to the battery while it was charging, and then, I believe, the next day it did 4 hours' work, and every other day that it has been in service it has done a full 8 hours' service. Those facts can be confirmed, sir.

The CHAIRMAN. You are under oath.

Mr. GOODWIN. I certainly am. I refer you to the electrical engineering department, building 77, General Electric Co., River Works, Lynn, Mass.

The CHAIRMAN. That is the only reason you were sworn in because we would not want to go back and check on your statement.

Mr. GOODWIN. I am giving you this, Senator, in full knowledge of my oath.

The CHAIRMAN. Yes, sir.

Mr. GOODWIN. The Hingham Naval Shipyard, formerly operated by the Bethlehem Shipbuilding Co., Hingham, Mass., is now operated by Hingham Management Corp. When these people started to lease buildings, the diesel switching engine and its batteries, which had been in mothballs for approximately 3½ years, would not take a charge. Our boys in Quincy treated these batteries in September 1951.

The CHAIRMAN. Did they do any mechanical work on this battery?

Mr. GOODWIN. No, sir.

The CHAIRMAN. Did they dump the solution out of the battery before they treated it?

Mr. GOODWIN. This engine has not lost a single day's work since that, which was 20 months ago. These batteries cost in the neighborhood of seven or eight hundred dollars or more.

These are facts which are self-evident, and do not need laboratory experiments for proof. For instance, when it is cold you wear warm clothes, and they keep you warm. When the weather is warm, lightweight summer clothes are more comfortable. There can be no dispute about this. Such is the case with certain benefits gained from the use of AD–X2.

If only 2 or 3 users reported that they did not have to add water as often to AD–X2-treated batteries, that could probably mean nothing; but when customer after customer, time after time, tells you that, as they usually put it, "I do not seem to use any water now," this must be the case. These people are not all gullible and stupid. The fact is that batteries treated with AD–X2 actually use much less water during their life.

The CHAIRMAN. What is the benefit where they use less water, what is the significance?

Mr. GOODWIN. Using less water?

The CHAIRMAN. What is the significance about that?

Mr. GOODWIN. It shows that the batteries are charging more efficiently.

Now, when you get a brandnew battery fresh from the manufacturer, fresh from the charging line, the active material in the plates is soft and spongy and porous, and the electrolyte action on that plate is formed in minute, small bubbles, the gassing action.

Now, as that battery becomes sulfated, that plate becomes sulfated, the gassing bubbles become larger, which indicates less efficiency of charging.

Now, contrary to the opinion that has been held here, sulfation gathers quickly, more quickly when a battery is new. Batteries sulfate very rapidly when they are new.

The reason why you get more trouble with sulfation when the batteries are old is because of the continued accumulation of sulfation, plus the harm that that sulfation has done during that time.

The CHAIRMAN. And the harm is in what manner?

Mr. GOODWIN. It is the harmful effects of sulfation on battery plates which is primarily the underlying cause for most battery failures.

Now, let me explain it this way: that as a battery sulfates it becomes less efficient. That means you have to charge that battery with more current in order to break that sulfation down as much as possible, to charge that battery up to full charge.

Now, most batteries are operated on some kind of an automatic charging basis. In an automobile it is a voltage regulator, in batteries on the lines, they have automatic equipment, and on these big forklift-truck batteries they have what they call constant potential charges, and the theory—now, I am not an engineer, and I could probably be tied up in the technical end of this, but I can tell you what really the essence of it is: that as the voltage in your battery rises it forms a back E. M. F., a back voltage force, which counteracts the voltage in your charging system, and as one meets the other, you allow less and less amperage to go through that battery.

Now, when a battery is charged up, and it is being charged, and it is inefficient, it takes longer for the voltage to rise. Therefore, in that case you are allowing more current to go through that battery over and above what should be required and it is harmful and damaging to that battery.

The CHAIRMAN. What does it do to the battery?

Mr. GOODWIN. It destroys the positive plates.

The CHAIRMAN. You mean it burns them up and destroys them?

Mr. GOODWIN. It deteriorates the grids on the positive plates. In the parlance of the trade it peroxides out the grids. Of course, we can get very technical here, but when you are charging a battery the lead peroxide, which is the active paste material on your positive plate, is tremendously more resistant to the electric current than is the grid, which is the frame which holds that paste.

Now, that frame is made out of pure lead with a small quantity of antimony or other substances to make it hard, to hold that active material together. It performs no other function than to hold that plate together.

The CHAIRMAN. Then, sulfation hardens that pasty material that is in the grid?

Mr. GOODWIN. No, that is not what I am trying to explain.

The CHAIRMAN. Or does sulfation eat it off?

Mr. GOODWIN. Well, sulfation is the cause of the extra charging, and the charging, instead of being received by the highly resistant lead sulfate, goes on to the lead frame which is, oh, less, a hundred thousand times less, resistant, and that changes—what they call in the business forms out—that grid to the same material as your active material. Therefore, it deteriorates the grid, and, as it is being done, slowly it cuts down the wire of the grid; so, therefore, it cuts down the current-carrying capacity of the battery.

The CHAIRMAN. So that a battery cannot hold as much, and when it is put back into service it soon exhausts itself?

Mr. GOODWIN. Well, the battery cannot release the current that is developed by the active material, and then, as you get further along with this peroxidation process, your grids become embrittled and they break and, of course, when they reach that stage you have no battery. That is a mechanical defect.

The CHAIRMAN. Then you think that the compound lessens the possibility of sulfation, and it is the sulfation that has the tendency to destroy the cells in that battery; is that what you are trying to tell us?

Mr. GOODWIN. Well, the sulfation is indirectly the cause. The actual cause of most failures in batteries that are used normally is overcharging, and the overcharging is due to the inefficiency of accepting the charge that that battery has, is able to accept efficiently. Therefore, it takes more current to charge that battery.

The CHAIRMAN. Well, the current is not the expensive part of it. What I am trying to get at here, to get out of your testimony, is the information that it is not the cost of charging, but it is the failure of the battery to deliver service after it has been charged; its life, its cycle, has been narrowed, reduced, in other words.

Mr. GOODWIN. That is right. But the point I want to make, Senator, is that overcharging, that extra surplus amount of electricity which is required to go into that battery, deteriorates that battery. That is constantly ruining that battery, and if you have a battery that is efficient, that all of your plates are working, are working all of the time, then you don't require that extra charging because your voltage comes up much faster, and your automatic charging equipment is cut down, and you do not require that extra current.

The CHAIRMAN. Even on an automobile battery?

Mr. GOODWIN. They are all the same, they are the lead-acid batteries.

The CHAIRMAN. Because you have an automatic control of the amount of current that goes into the battery. If the battery is full, your automatic control shuts off, and you are not throwing any current in there at all.

Mr. GOODWIN. That is right, providing your control is working right; sometimes it doesn't.

The CHAIRMAN. If you did not have that control on it, you would burn the battery up?

Mr. GOODWIN. Yes, sir. You see—you mention a battery burning up. The same thing happens in a much slower way from what I have been describing.

AD–X2 increases charging efficiency in batteries in service so much so that customer after customer will inquire if anything is wrong with their ammeter, because the needle always seems to stay in the center, which makes them fear their charging equipment is not functioning properly; when, in fact, this really indicates that the battery is constantly in a fully charged condition, due to the ability of that battery to accept efficiently the charging current from the generator. These people are actually concerned because this is a different indication to what most of them have experienced prior to using AD–X2.

After batteries have been run down from trying to start a cold or stubborn motor, or when an ignition key has been left on all night, an AD–X2-treated battery charges up in less time than an untreated battery, at any time during its entire life, except when the battery is new and fresh.

This condition is apparent in the automobile or truck, so much so that we are hearing about it all the time from different people—we are not just kidding ourselves. I think you will find the results of the tests at MIT and United States Testing Co. lend credence to the above statement.

There is a large company in Boston which has tried out a few treatments of AD–X2 in batteries which are used in trucks equipped with telephones.

These trucks cover the city territory and, as a result of many stops, plus the drain of the phones, and the fact that these trucks get no real mileage, makes it difficult to keep the batteries in a charged condition, thus requiring frequent changing of batteries.

Last week I called up the supervisor, and to date they have not experienced the usual trouble; the batteries are operating without the usual charging, and have been in operation 3 to 4 months. This is a practical example of increased charging efficiency. This company's name will be furnished the committee should it so desire.

Ordinarily, car owners are wary and cautious about using their radios too much because their experience has shown them that this will run down batteries and, therefore, cause trouble. This is especially so while a car is parked with the engine not running.

It is a warm experience to have so many users of AD–X2 voluntarily tell you that they now do not even think of a battery while operating their cars and radios. If this happened only occasionally it might not mean anything. However, it is just an every-day, common occurrence with us. Radio hams with transmitting equipment in their cars are real boosters for AD–X2—that is, those who have used it.

We do not claim to make a battery operate better than a fresh, new battery. The trouble with a fresh, new battery is that it does not stay in this condition long, as the hard lead sulfate forms rapidly at the beginning, making the battery deteriorate in efficiency.

AD–X2, by reducing the harmful effects of sulfation, keeps a new battery in a fresh, new condition for a much longer period, and also brings back to top efficiency those batteries which are mechanically sound but whose efficiency has deteriorated from the effects of harmful sulfation.

Capitol Motor Transporation Co., Everett, Mass., operates in the neighborhood of 200 large units. This concern was not primarily interested in longer life, greater efficiency, as such, less water usage, and so forth; all they were interested in was in not having to change batteries when drivers ran the batteries down starting the motor or when ignition switches were left on overnight.

Eighteen months ago we treated approximately 35 batteries in trucks for this concern, and now they have gone over 100 percent to using AD–X2 in their new batteries, the main reason being that when on cold mornings—most of the equipment remains outdoors—and batteries are run down by the drivers, and so forth, it is necessary only to start the motor with a booster battery; and the battery which has been run down is charged up quickly and efficiently by the vehicles' own charging generators.

This one feature has saved a lot of inconvenience, trouble, and expense. In addition, these treated batteries have lasted approximately 50 percent longer than untreated batteries in the same service, and are still in operation and working at top efficiency.

Due to accident, the cases on 2 treated batteries were crushed and 2 others had the electrolyte spilled out after giving considerable service. Those batteries were taken apart, and the plates and separators examined. These were in such good condition that the manufacturer

of these batteries found it hard to believe. All four of these batteries were reassembled, using the same plates, and are still in operation.

The truck maintenance superintendent of this concern is well known in the transportation field in Boston. He is exceptionally capable, and not one who would be considered gullible by any stretch of the imagination.

It is also not necessary to conduct laboratory tests to show that gassing in AD–X2 treated batteries is in the form of fine pinpoint type bubbles instead of the usual large type bubbles. Anybody with average eyesight can easily notice this condition by just looking at it. In glass cells this cloudlike formation of extremely fine bubbles makes a pretty picture, a picture of battery plates working at top efficiency.

The above is the main reason for less water usage, getting less acid on battery covers and cases, also giving off less destructive acid fumes, and lessening the danger of electrolyte dropping below the plate top level.

There is a large cold-storage concern in Boston which has been conducting engineering experimental work through their electrical engineering department on AD–X2. These people have been able to reduce considerably the rate of charging current needed to charge a bank of AD–X2-treated electrical substation switch-tripping cells, yet keep them fully charged.

Gentlemen, sulfated batteries require more charging current to keep the batteries properly charged. This extra charging current is injurious to the batteries and this shortens their life. This controlled experiment supports our claim to increased operating efficiency.

This same concern also had two batteries taken apart, large industrial truck batteries, both approximately 6½ years old, and both doing similar work, the only difference being that one had been treated with AD–X2 6 months previously.

Upon inspection of the plates, the positive plates of the AD–X2-treated battery showed better condition than the positive plates in the untreated battery. Had we been able to treat this cell at an earlier date, the differences would have been even greater.

However, the negative plates showed a tremendous difference. The active material in the negative plate in the untreated battery was hard and slaty, with cracks running through, and the material was clearly defined at the grids.

On the other hand, the active material in the negative plate of the treated battery was soft enough to be scooped out with a thumbnail.

The plate looked in excellent condition, and the active material was in tight contact with the grids. No cracking was apparent and you could not see where the active material ended and the grid began. This is the condition a negative plate should be in. It is a known fact that negative plates are more subject to being sulfated. May I repeat, this plate was approximately 6½ years old.

I have not mentioned the name of this concern, but I feel sure this committee would have access to these records, should they desire.

I could go on and on with similar experiences. When cases like this were brought to the attention of the Bureau of Standards they said they didn't mean anything as they were not controlled experiments. Their mind was completely closed; their results were not even to be questioned.

We have had a terrible fight on our hands. It is awful to have a product which has performed so many wonderful feats and which will increase battery efficiency and cut battery costs, and yet to be frustrated at every step in trying to merchandise it.

The Bureau's attitude has been anything but cooperative. I wonder how many other small-business men and new products have been stymied by this same Bureau? Again I am forced to wonder what is back of it all. It is an example of bureaucracy at its worst.

It is about time something was done to make the climate for small business more healthy, for without small business this country couldn't exist.

Unless the United States Bureau of Standards is removed from this picture, I see no other alternative but to give up. I am getting too old to fight the United States Government.

I am both a loyal citizen and a taxpayer, a taxpayer paying taxes to a Government which has been browbeating me for two and a half years; a taxpayer to a Government which has been denying me the right to make a living for myself and my family, a situation which in this great land of ours should be unthinkable.

The CHAIRMAN. Have you ever tried to learn what is in the compound?

Mr. GOODWIN. No, sir; I haven't. Of course, in all of this discussion with the Bureau of Standards, naturally the situation has come to my attention, but I am not a chemist and I have had Mr. Ritchie's word for it.

The CHAIRMAN. Does it make any difference?

Mr. GOODWIN Not in the slightest. The experience that I have had from my customers has shown me just what the product will do.

Well, you say, does it make any difference? When I first started to sell this product, it probably might have made some difference at that time because, naturally, if it was the same as other additives that had not worked right, about which I had talked to different battery men, that is one thing. But I had been given the assurances from Mr. Ritchie that it was different, and I have found him to be honorable in all my dealings with him.

The CHAIRMAN. Is he any relation of yours?

Mr. GOODWIN. None whatsoever.

The CHAIRMAN. But would it make any difference if it were just plain glauber salts and epsom salts, and it gave you the results that it does?

Mr. GOODWIN. Well, after the experience that I have had, it wouldn't. That is all I am going by.

The CHAIRMAN. You have referred to the military authorities in that statement. Did you clear with the military authorities so that they were aware of what you were going to say in that statement?

Mr. GOODWIN. No, sir.

The CHAIRMAN. Concerning the tests?

Mr. GOODWIN. No, sir.

The CHAIRMAN. Would you have any reason to believe that the military authorities would have objected had they known that you were going to refer to them?

Mr. GOODWIN. Certain military authorities would not, and others might because I have had men—and I would never disclose any names or ranks because you can see the reason why——

The CHAIRMAN. But I mean some of these batteries that you have treated were the property of the military forces.

Mr. GOODWIN. Like the Boston Army Base?

The CHAIRMAN. Yes, sir.

Mr. GOODWIN. There was a case where a facility is allowed to use its own discretion in time of emergency.

The CHAIRMAN. The only reason that I asked this question was to determine whether, in the event we should desire to have a statement from that base, they would support your statement.

Mr. GOODWIN. The civilian engineer in charge there, I am sure, would support my statement, I feel sure, and he would not feel embarrased about doing it. He would just be making a statement of fact.

The CHAIRMAN. Since you started your statement, the military base has been called, and for the sake of the record I am going to let the gentleman who talked to the military base make his statement at this time for the record.

Mr. GOODWIN. O. K., Senator.

The CHAIRMAN. That was Mr. O'Connor. He is a committee staff member. I am going to swear you in, Mr. O'Connor.

Mr. O'CONNOR. Very well.

The CHAIRMAN. Do you swear that the testimony you are about to give pertaining to the matter now before this committee is the truth, the whole truth, and nothing but the truth, so help you God?

Mr. O'CONNOR. I do, sir.

A stenographic transcript of my conversation with Mr. Theodore Sharon, general foreman, superintendent of maintenance and construction, of the Boston Army Base, will be available to you in a few moments.

The CHAIRMAN. When was this call put in?

Mr. O'CONNOR. Within the past 15 minutes.

The CHAIRMAN. Since Mr. Goodwin commenced reading his statement?

Mr. O'CONNOR. Yes; shortly after he referred to his experience with the fire-alarm system batteries.

The CHAIRMAN. You were not aware of what Mr. Goodwin had in this statement?

Mr. O'CONNOR. I have not seen his statement.

The CHAIRMAN. Because he made that statement you then called the base?

Mr. O'CONNOR. That is correct. I didn't even have a name.

The CHAIRMAN. I was not aware that you were calling the base.

Mr. O'CONNOR. That is correct, sir. I didn't even have the name of the superintendent; I had to find that out. But, in brief, Mr. Sharon stated that the results that they had obtained from the use of AD–X2 in the batteries under discussion here astonished the people at the Boston Army Base.

Before treatment with AD–X2, the batteries were considered practically dead. Prior to treatment they had had to charge the batteries once a day. After treatment, they found it necessary only to charge the batteries every second or third day—and "We are sold on the stuff."

The CHAIRMAN. You are quoting?

Mr. O'CONNOR. I am quoting what Mr. Sharon said. That is the sum of the conversation with Mr. Sharon.

The CHAIRMAN. Mr. Goodwin, have you anything further that you would desire to say?

Mr. GOODWIN. In regard to that?

The CHAIRMAN. No. If you care to comment on that, yes; otherwise, I mean, in your regular statement.

Mr. GOODWIN. Well, I will say that those batteries wouldn't stand a charge, take a charge, for over an hour, but, of course, this is some time back, and you call a gentleman, and unless he can, you know, go to records, it is sometimes hard to believe, and I don't want to put Mr. Sharon in any—I feel very pleased that he has corroborated my testimony.

The CHAIRMAN. What would be your opinion in the event that AD–X2 were placed in submarine batteries? You understand that the submarine battery must furnish the entire power for that submarine while it is submerged. Then, it must surface in order for it to be charged by the motors—that is, the gasoline or the fuel-driven motors—and then it submerges, and must then rely entirely on batteries to furnish the power.

Mr. GOODWIN. I am acquainted with the operation.

The CHAIRMAN. In the event the compound were to lengthen the ability of the battery to furnish the power it could stay submerged longer; could it not?

Mr. GOODWIN. That is right.

The CHAIRMAN. And the life of the battery, if it could be extended with AD–X2, then it would materially lower the cost of replacing the batteries in submarines?

Mr. GOODWIN. Very much so.

The CHAIRMAN. Have you ever endeavored to try to experiment on submarine batteries?

Mr. GOODWIN. I have, sir, but I am——

The CHAIRMAN. Have you tried to sell any of the military authorities on the idea that you be allowed to treat some of the batteries in submarines?

Mr. GOODWIN. I have, sir, and I am in a rather peculiar position, I do not want to put any officers and men who are working for the betterment of their service in trouble, but, so long as you have asked me, I have to answer your question. I have already treated a submarine cell in New London. And, from what I understand, the results are simply astonishing.

The CHAIRMAN. When was this done?

Mr. GOODWIN. This has been done—it is about 7 weeks now.

The CHAIRMAN. About 7 weeks?

Mr. GOODWIN. Yes.

The CHAIRMAN. How can you determine the results of it in only 7 weeks' time?

Mr. GOODWIN. The results were so astonishing—I could tell you a lot about this.

The CHAIRMAN. Who is taking the mechanical readings on it?

Mr. GOODWIN. The expert battery chief petty officer in charge of the battery room, a man who is very well qualified to do that work.

The CHAIRMAN. Why are you so hesitant about talking about it? Understand, I know nothing about it.

Mr. GOODWIN. The only reason is—that is right, Senator—the only reason is I have enjoyed the confidence of the officers at the base, and

I purposely left this out of my testimony, much as I would like to have brought it in, because——

The CHAIRMAN. I was not aware of it; it was a question that occurred to me because I know of the number of storage batteries and men's lives that are dependent upon the ability of those batteries to perform once they are out at sea, and that is the reason I asked the question.

Mr. GOODWIN. Well, I will answer your question, Senator.

I called on the submarine base in New London after they had written to me for quotations on prices, and I called them up and told them I would be only too pleased to go down there and discuss the matter, and they were delighted to have me do it.

When I got there I saw one of the commanders, and they had had this very much in front of them, but, of course, not being approved by the National Bureau of Standards, and so forth, they didn't dare to even make any experiments. So, what happened? They wanted to get some actual factual proof, and the engineering department down there looked around, and they picked up an old forklift truck battery that was 7 years old, and said: "Now, treat that."

At first I didn't want to do it. So, finally I asked one of the men to pull one of the cells out. They couldn't pull the cell out, and I found the man had a hook underneath the positive strap.

The CHAIRMAN. This was not a submarine battery?

Mr. GOODWIN. I am leading up to the submarine battery, sir.

The CHAIRMAN. O. K.

Mr. GOODWIN. This predates it, and it leads up to it, and so when they lifted the strap up and the battery came with it, I knew that the grids in that cell must be all right. So then I treated that cell on the basis—they had no funds for it unless we could prove that we could do something—on the basis if it didn't work they wouldn't have to pay for it.

That cell prior to that time was considered junk, it was going probably an hour a day under discharge.

They had charged that battery for 4 days and 4 nights, and they hadn't been able to get the specific gravity above 1.130.

A battery in that condition is just junk so far as anybody is concerned. I treated that battery and it came back to over a hundred percent capacity. They were so amazed at this battery running around there now, it is just something out of this world to them; and, to an outfit that has to deal so much in batteries, why, it is a revelation to them.

The CHAIRMAN. You were leading up to the submarine battery, that is what I am getting to.

Mr. GOODWIN. The next thing that happened was the medical department of the New London Submarine Base became interested in the gassing problems of batteries.

Now, on submarines, gassing is a serious thing because you get toxic gases.

Now, if AD–X2 could cut down that gas, why, that would be ample reason for trying it under power conditions on submarines. But, they decided they were going to do something about that. In the meantime, there was a battery cell on the *Flying Fish* submarine which had not been operating right from the time that it was on the boat, and it had gone through half of its life, about 300 cycles.

Well, they had done everything possible to bring this cell back to life, even to taking it off the battery.

First of all, the actions of this cell were such that the voltage went down very rapidly, and when it was charged up the voltage went much higher than the other cells and, therefore, was a drain on them.

The CHAIRMAN. How big a cell would that be?

Mr. GOODWIN. A 10,000-ampere-hour cell. It stands up about this high.

The CHAIRMAN. How high? The reporter cannot report "this high." Tell us in feet.

Mr. GOODWIN. How high is that?

The CHAIRMAN. I would say a good 5 feet.

Mr. GOODWIN. Five feet by fifteen inches, by twenty inches.

The CHAIRMAN. That is the size of this cell now that you have reference to?

Mr. GOODWIN. That is right. There are 252 of those in a submarine.

The CHAIRMAN. How many?

Mr. GOODWIN. 252.

The CHAIRMAN. Of those cells?

Mr. GOODWIN. Yes, sir. They cost approximately in excess of a quarter of a million dollars, and I believe there is an installation cost of about $80,000.

The CHAIRMAN. All right. Now, what did you do to that cell?

Mr. GOODWIN. Well, this cell—they took it out last October and November, and brought it into the battery shop, and they gave it several long, slow charges and discharges. Now, that is what the Bureau of Standards says will do everything that AD–X2 will do. You give a battery a good long slow charge and a good long discharge, slow discharge, and you cycle it, and you make your battery fine.

Well, they did that several times. They had examined the plates and found they were mechanically sound. They put the battery back in the submarine, and then after a couple of months it started doing the same thing, and for the final 3 months they had that cell jumped over. Therefore, they decided to junk that cell.

The cell was brought up into the battery shop. I was called down. I treated that cell. On the first discharge we got 98 percent capacity.

The CHAIRMAN. Go ahead.

Mr. GOODWIN. They made another discharge, and they got a charge and discharge—they even got a higher capacity.

I understand the water loss on these cells is so small compared to the water loss in other cells that they are really amazed.

Now, to the present time they haven't got around to testing the gassing on the other cells, and I am sincerely in hope, Senator, that my testimony here will not prevent the further testing of this product by this outfit.

The CHAIRMAN. Well, if there is any information that there is any interference with carrying out the tests to their conclusion about that, I want to know. Nothing can be more serious. If any agency of the Government stands in the way of some scientific research in submarine batteries I want to know it. Those batteries are the lifeline of the men once that submarine submerges, because then they no longer can depend upon the motors to furnish the power.

Mr. GOODWIN. I want to make a statement here, too, that the officers and men down there are very much interested in increasing the efficiency of their operation, in protecting the lives of their men, in doing everything they can to better their operation.

I never saw such fine cooperation from any place in my life, anywhere. You can understand my feelings in the matter, and that is why I had not intended to make any statement of that.

The CHAIRMAN. I was not aware that you had done any work on those submarine batteries, but I do know what a submarine looks like inside, and for that reason the question came out, because of my curiosity.

Mr. GOODWIN. I will also tell you that the temperatures on this cell were considerably lower on charging than what is normally the case.

The CHAIRMAN. This cell that you treated?

Mr. GOODWIN. That is right.

The CHAIRMAN. The temperature was running lower?

Mr. GOODWIN. That is right.

The CHAIRMAN. And they have a question, once they submerge, of how to keep the temperature down.

Mr. GOODWIN. And the current, the discharged current, was more even and steady, which shows an efficient battery operating there, an operating battery.

The CHAIRMAN. Anything further that you have to say?

Mr. GOODWIN. Well, after July 5 or 6, they expect to go ahead and make some tests on the gassing, and in a couple of other cells, one treated with AD–X2 and one not, and then that has to be straightened out before anything else.

The CHAIRMAN. Does that conclude your statement?

Mr. GOODWIN. That concludes my statement.

The CHAIRMAN. This will conclude the hearings for the time being. We have quite a number of Appropriations Committee sessions or committee meetings that will have to be carried out. My own Appropriation Subcommittee has its report ready. I must be present when the full committee gives consideration to the subcommittee's recommendations and, therefore, we will have to discontinue the hearings for a few days. For the present this will conclude the hearings.

(Whereupon, at 1:10 p. m., the committee adjourned, subject to call.)

APPENDIX

(Since Mr. Schlink did not personally appear before the committee his statement is submitted for the record.)

STATEMENT OF F. J. SCHLINK, PRESIDENT AND TECHNICAL DIRECTOR OF CONSUMERS' RESEARCH, INC., FOR THE SENATE SMALL BUSINESS COMMITTEE, JUNE 26, 1953

My appearance here today is that of one with long experience with the methods and point of view involved in testing items bought and used by the ultimate consumers. I am president and technical director of Consumers' Research and my work on ultimate consumers' goods goes back to 1913, when I tested weighing scales for the Bureau of Standards.

The aim of tests of products made for consumers is to reproduce or to simulate conditions involved in the consumers' use of the product, so far as practicable. If the findings are to have value for the user of the article, the purpose of the laboratory test will not be one of trying to support the manufacturer's claims or arguments, nor should the methods of testing be those devised by the manufacturer.

The reason for setting up laboratory techniques for testing is primarily that conditions of actual use are extremely variable—too variable as a rule to permit the drawing of conclusions which would be reliable and have general validity. It is necessary to limit the scope of the investigation and to set up certain acceptable standard conditions, in order that results can be gotten within a reasonable time, and also to eliminate questions of personal judgment and opinion insofar as practicable. It is important, however, that whatever the laboratory tests may be, they should be directed to the fundamental properties of the article or product which determine its usefulness in service. Test methods which merely show that a product has different ways of acting than other products previously used for the same purpose do not get to the heart of the problem which concerns the consumer, which is: Does the product produce the result, or improvement, or economy, or render the service which is claimed by its manufacturer in his sales arguments and advertising to prospective customers?

In the case now under consideration, two opposing concepts have been sharply brought into focus. One is the idea advanced by the manufacturer of AD–X2 that the only proper test of a product is one which is carried out in accordance with his instructions, and by methods designed to bring out the good points or merits of his product. The other concept, represented in the work of the National Bureau of Standards, is that a proper test should simulate, so far as possible, conditions of use. If there is an improvement produced by AD–X2 in the performance of a battery, it will be disclosed by tests of batteries under conditions closely similar to practical use in an automobile—which is the major application of storage batteries.

An example of how a testing laboratory can be misused is given by work done on ballpoint pens by a commercial testing laboratory after Consumers' Research had demonstrated by its tests that the ink of the ballpoint pens then being sold faded rapidly in daylight or sunlight, so that the writing was wholly unsuited to all important record work involving the need for permanence, as in wills, deeds, and other essential documents. As might be expected, one of the pen manufacturers involved was considerably disturbed at our report. In an endeavor to refute our findings, he hired a large commercial testing laboratory to prove that his particular ink did not show rapid fading. The press release which the pen company sent out claimed that results of laboratory fading tests carried out for it proved that a new colorfast, permanent ink developed for ballpoint pens exceeded Government nonfade requirements 2½ times. The

statement that the ink exceeded Government nonfade requirements 2½ times was wholly misleading because there were then no Government requirements for ballpoint pen inks. Reasonable requirements as to resistance to fading would have been those which apply to the performance of good writing and record inks. The ballpen ink in question faded out almost completely in 9 hours in the test and completely in 18 hours, whereas the standard Government record ink in the same time would show hardly any color change and no loss of legibility whatever.

A common use of a testing laboratory by advertising men is to provide a report which capitalizes on the consumer's high regard for science to persuade the reader of advertising claims that the product is valuable and has the properties claimed for it, on the authority of scientific experts. The laboratory may, and often does, provide an impressive report which sets forth measurements or judgments of properties of the product which are not mentioned or emphasized in the advertising, and, therefore, are not actually relevant. In such cases, the consumer is led to believe through an impressive laboratory name, report form, the technical terms, and abundance of data, that the claims and testimonials are somehow supported by the findings of the laboratory. In most cases, however, the consumer does not have technical training to judge the correctness or relevance of the report and to understand whether in truth it does establish the claimed qualities or performance of the product. An example is that of a widely sold chemical automobile specialty alleged to make "tired engines turn tiger" and "increases gas mileage," "gives motor longer life," when it is added to the lubrirating oil in the crankcase of an automobile. On the reverse side of the advertisement which makes these claims is a letter and a test report of a well-known commercial chemical and engineering laboratory which presents certain measurements on this product. On the basis of these measurements it was stated that the mixture was superior to six other unnamed "tuneup oils." Yet no test was included in which the product was used in an actual engine, and no proof was offered on the three most important claims made by the manufacturer; namely, an increase of gas mileage, giving of longer life to the motor, and making a "tired engine turn tiger."

Examples of misuse of scientific tests and opinions in advertisements to the injury of consumers are numerous, and the files of Consumers' Research and the National Bureau of Standards would reveal enough such cases to fill a book. The example just cited will suffice to illustrate a problem with which honest business enterprise, responsible testing laboratories, better business bureaus, and many other agencies are greatly concerned.

The immediate application of these examples to the case now under discussion is to be found in certain sections of the much-discussed MIT report which indicated that AD–X2 had some effect on the battery under conditions set up in the MIT laboratory. The important factor which was not discussed or revealed by the MIT report was: Was the effect one in which the consumer would be interested, and which would give his battery longer life, as claimed, or restore it to normal functioning? The tests carried out were competently conducted within their limits, but their limits were so narrow that they did not provide an answer to the question which is the only one of importance, from the standpoint of the consumer who is going to spend his hard-earned money for a battery additive: Do these tests show that if I buy AD–X2 and put it into the cells of my battery, it will make the battery give better or longer service than if no treatment had been applied?

The next point that I should like to discuss from the consumer's point of view is the use of testimonials in advertising and their lack of standing as scientific evidence. There was a classic series of articles on the subject of patent medicines written by the late Dr. Arthur Cramp of the bureau of investigation of the American Medical Association back in 1911 to 1936. These presented careful studies of the many quack medicines including a host of testimonials for fake cancer cures, cures for tuberculosis and diabetes and other dangerous maladies. Dr. Cramp gave a number of instances where the person who had stated that he had been cured by the remedy either had been dead several years at the time the advertising appeared, or died later from the very disease the product was claimed to cure. The able pioneering work of Dr. Cramp in this field was one of the important influences in bringing about the enactment of the present Food, Drug, and Cosmetic Act. There was also an excellent series of magazine articles in March and April 1931 by the late Alva Johnston, entitled "Testimonials C. O. D., Wholesale, and F. O. B.," in which he set forth the procedure used and prices paid for testimonials for a well-known cold cream, toilet soap, yeast, cigarettes, and a number of lesser products. In fact, in one record day, a motion-

picture actress "endorsed" 400 articles ranging from aspirin tablets to a grand piano. (This was considered an epic of the testimonial-advertising industry.)

To characterize briefly the attitude of scientific investigators: Scientists generally give no weight to testimonials as evidence of the value of a product. They correctly hold that the opinion of an unskilled person or one not professionally qualified has no value in judging the performance or lack of performance of a product. It requires vigorous professional training and skill and expert judgment to produce an evaluation that warrants serious consideration. One who would judge product performance reliably must have some basis of comparison of the performance of the given product with others, or with some sort of standard or norm so that he may know whether the product can actually be said to have been responsible for the good or bad performance, or whether some other factor was the cause, or whether the result alleged to occur might not have occurred whether the product claimed to produce the favorable performance had been used or not. It is well known that in cases at law, testimony by laymen about scientific and technical matters does not have standing, and there are a number of good reasons for this rule.

The elaborate statistical studies employed by MIT in arriving at its findings regarding AD–X2 and emphasized in certain published discussions of the MIT studies reflect a curious lack of sensitiveness to the rights of the ultimate consumer in respect to the sale and use of an advertised article. From the consumer's standpoint, since the advertising makes no exceptions in its claims, every sample of AD–X2 should improve the performance of every battery to which its use is applicable. This improvement should be substantial, and not so small or uncertain that it could be detected only by intricate and involved laboratory techniques, or by the application to the test data of elaborate statistical processes. The only reason for application of statistical methods in a case of this kind would be in circumstances where the effect is so slight that it is detectable only by testing many samples and analyzing the data on a probability basis; or if the product is one which sometimes works favorably and sometimes works unfavorably, or not at all. Neither of these situations was, of course, indicated in the advertising and publicity for AD–X2, which gave the impression that if the product was applied to a particular storage battery, it would work without fail, every time, and give a substantial, clearly evident, money-saving improvement in battery performance.

In the case of a conflict between the manufacturer and one of the consumer-protective agencies of the Government on a matter of advertising and claimed performance of products, the function of the Bureau of Standards, in scientific testing of consumers' goods, is that of an impartial testing agency whose results would be accepted without doubt or question by the courts, the Federal Trade Commission, the Division of Mail Fraud Investigations of the Post Office Department, the Federal Communications Commission, Food and Drug Administration, and better-business bureaus throughout the country.

Matters of salability, marketability, market acceptance, etc., are no proper concern of the Bureau of Standards or of any other physical or engineering science institution or laboratory. Such questions should remain strictly the province of people whose business it is to sell goods, not to test them. The fact that consumers are willing to buy something is not the ultimate criterion of its merits or value in use, as is well exemplified in the case of drugs, such as sleeping tablets, cocaine, heroin, marihuana, which, like many other harmful or poisonous articles are in substantial demand in the market place.

The importance of having the National Bureau of Standards conduct, or at least supervise tests made for the needs of Federal enforcement agencies, is that experts working on a project involving technical and scientific tests should not only be qualified and competent in the field of the science and technology in question, but they should be disinterested and have nothing to gain either in money, prestige, or any other thing of value, whether the product which they are examining shall be found to have substantial merit or to be almost or entirely without merit. It would, for example, be considered unsound policy to ask an engineer from a company manufacturing a refrigerator to decide for the public or for a Government agency on the relative merits of his refrigerator as compared with those of his competitors. Furthermore, he would not normally be qualified even to decide upon proper test methods for his appliance, because the tendency always exists for an interested party to select a test method which will favor a particular make or type of product, and to be against applying test methods which will give an advantage to the product sold by his competitors. The correct way to arrive at fair and adequate test methods is to simulate as closely as practicable, the use of the product in question under actual service conditions.

This approach, as it happens, was not followed by MIT in its tests of AD–X2 as the Bureau has well shown, and the MIT methods were notably different in character from those which would apply to the action of a battery in regular service in a consumer's car.

May I conclude in this way: I recognize the Senate Small Business Committee restricts the scope of its activities to working for the interests of the small-business man, but I would like to point out that you, as Senators of the Congress from various States in the Union, of course represent a much wider field of interest, namely that of all the consumer-taxpayers of your respective States. The needs and rights of consumers in this whole picture has been somehow lost sight of, and in my opinion the able work that the National Bureau of Standards has done in its tests of this product have rendered signal service to consumers who, as I have already pointed out, have a right to know whether the product will perform as advertised. The concept that the consumer has a right to receive protection by the Federal Government from economic frauds and gyps as well as from dangerous drugs and contaminated foods is a comparatively new one in the line of legislative history of consumer protection. In carrying out the various laws passed by Congress for the protection of the consumer, considerable work has had to be done in formulating test methods. The National Bureau of Standards has been one of the pioneers in this field and has contributed greatly to the development of methods for testing products under conditions which simulate those of actual use. The Bureau is highly regarded by those interested in consumer protection and consumer enlightenment, as an impartial and effective agency in many important fields of physical and engineering science. It would be a pity if its present efforts in behalf of consumers were restricted and its work reoriented toward development work for manufacturers. May I respectfully urge this committee in evaluating the extensive testimony to which it has listened in this particular case to keep in mind that to favor the interests of a small-business man over that of the consumer will be looked upon as singling out a minority interest for special favors. To act with the interests of the consumer in mind will serve the greatest number of people in this country, namely, the consumer-taxpayers, from whom comes the financial support, not only of the Federal bureaus, but also of the Congress of the United States.

EXHIBIT 1

KEYSTONE BATTERIES, INC.,
San Francisco 24, Calif., February 2, 1950.

The ASSOCIATION OF AMERICAN BATTERY MANUFACTURERS, INC.,
2706 First National Tower, Akron 8, Ohio.

(Attention: Mr. W. L. Smithers.)

DEAR MR. SMITHERS: We have your letter of December 23 with enclosures which were very helpful to us.

When the AD–X2 first came out, we thought they would kill themselves off in short order like most of the other battery additives in the past, but they seem to be getting stronger and reaching out further all the time, and they will probably reach midwest and east unless something is being done.

As we understand it, they are now appointing dealers in various cities on the west coast who not only try to sell this preparation but also will recondition a stock of old batteries which they will guarantee for 12 months. The dealer picks out all batteries which show voltage in all cells and undertakes to "rebuild" same at prices ranging from $7.00 to $14.00 on a 6-volt and $25.00 to $27.50 on a 12-volt battery depending on the size. Any batteries which show dead cells they turn down. From their point of view, this is a sweet business because we have been informed that all they do is charge these batteries or at the most, reinsulate them, which shows a considerable profit.

We heard that they sold the Army Ordnance Department in California $25,000 worth of AD–X2, but the Ordnance Department in Washington has since issued a bulletin to all departments stating this AD–X2 to be of no benefit to batteries and instructing them to stop using same. Is there any way we can verify this?

We think it will be of benefit to all members if the association came out with a bulletin quoting Bureau of Standards pamphlet, part of Geo. W. Vinal's letter dated December 7, 1949, and this Army bulletin (if available).

We were informed that the "Tire, Battery and Accessory News" (published by the Trade Press Bureau, Kansas City, Mo.) and are endorsing this preparation

probably on the strength of receiving an ad from the AD–X2 people, and we think it might be a good idea if the association brought some pressure to bear on this magazine and made them retract this endorsement. If they refuse to do this, I feel sure that they would lose most of their subscriptions and ads from battery manufacturers, etc.

This is a serious situation. We know that we have lost a considerable amount of business for last month alone and the loss of business to large manufacturers must have run into thousands.

We feel sure that with the cooperation of the association and all its members we will be able to lick this thing. Looking forward to hearing from you, we are

Very truly yours,

KEYSTONE BATTERIES, INC.
W. BRIZEE, *Secretary.*

THE ASSOCIATION OF AMERICAN BATTERY MANUFACTURERS, INC.,
OFFICE OF THE COMMISSIONER,
Akron, Ohio, March 10, 1950.

The FEDERAL TRADE COMMISSION,
Washington, D. C.

GENTLEMEN: I am attaching copy of a letter received from Keystone Batteries, Inc., of San Francisco, Calif., dealing with the distribution of a material, AD–X2, which is sold under the claim that it will rejuvenate old batteries.

At one time the association tried to combat the use of dopes or trick electrolytes because after a group of them had been carefully tested in the laboratory it was found that none of the materials tested had been helpful in battery performance and some of them were actually harmful. Many of these were reported to the Federal Trade Commission from time to time. Cease-and-desist orders were issued by the FTC, but the companies would spring up in other localities under different names and it became a hopeless effort.

Moreover, retailers of the dopes used as an argument for selling the materials that the battery industry is interested in obstructing the use of the materials because they would lengthen the life of a battery and reduce sales. This was not the case. The industry was simply trying to protect its product against introduction of foreign materials and at the same time prevent the public from spending its money for something of no value.

Because of the above, the association decided to discontinue entirely its efforts in this regard. All this office does when a complaint reaches us is to enclose a pamphlet issued by the Better Business Bureau in which is reprinted a statement by Dr. Condon, of the Bureau of Standards.

We believe the FTC should take some action in regard to the enclosed complaint in the interest of both battery manufacturers and battery consumers. Before doing so a careful analysis of this material should be made for to my knowledge none of our members of the association has done this. The material was introduced after we discontinued our effort in these matters.

THE ASSOCIATION OF AMERICAN BATTERY MANUFACTURERS, INC.,
V. L. SMITHERS, *Commissioner.*

EXHIBIT 2

(Retained in committee files.)

EXHIBIT 3

DEPARTMENT OF COMMERCE, NATIONAL BUREAU OF STANDARDS

LETTER CIRCULAR LC 302

(May 15, 1931, reissued March 21, 1949)

BATTERY COMPOUNDS AND SOLUTIONS

The National Bureau of Standards receives many inquiries about materials which are said to charge storage batteries or otherwise improve their performance. More than 100 of such materials have been brought to the Bureau's attention during the past few years. A statement entitled "Solutions Do Not Charge

Storage Batteries" was issued in the Bureau's Technical News Bulletin No. 94, dated February 10, 1925. This statement was based on tests of typical materials available at that time. Since then additional tests on solutions and compounds, the latter in the form of salts to be added to the battery electrolyte, have been made. The later tests confirm the Bureau's previous conclusions that these materials do not charge storage batteries nor do they materially improve the performance of the batteries.

Careful tests have shown that batteries containing these solutions behave essentially the same as similar batteries not containing the materials in question; that is, no essential improvements in the capacity of the batteries, the time required for charging them, the operating temperatures, or the amount of water which must be added to maintain them, have been observed.

It has been shown that batteries are not charged by changing the solutions and that the time required for charging is not decreased. The word "charge" as applied to the storage batteries has a distinct technical meaning. The American Institute of Electrical Engineers has defined the word "charge" as follows: "Charge. The conversion of electrical energy into chemical energy within the cell or battery. This consists of the restoration of the active materials by passing a unidirectional current through the cell or battery in the opposite direction to that of the discharge. A cell or battery which is said to be 'charged' is understood to be fully charged." This definition indicates clearly that the charging process is the restoration of the active materials of the battery by an electric current.

Careful comparison of batteries containing such solutions or compounds with similar batteries not so treated have shown that in either case a half-hour charge, the battery being discharged initially, will permit the operator to withdraw ampere-hours equal to about what has been put in during the one-half-hour charge, and similarly, if the charge is continued for 1 hour the equivalent of the 1-hour charge can be withdrawn. This is in accordance with fundamental laws of physics and chemistry.

The claim is often made that batteries containing these solutions will operate at lower temperatures when being charged by an electric current. The temperature to which the battery will rise depends upon the amount of heat energy which is liberated within the battery and the radiation of heat from the battery. Assuming two batteries to radiate heat equally, the one which has the higher internal resistance will operate at the higher temperature. The electrolyte is only one of several factors in determining this resistance. Careful comparison between batteries containing these solutions or compounds and similar batteries not so treated have shown that there is very little, if any, difference in the operating temperatures under comparable conditions.

Likewise the claim is often made that the use of such solutions or compounds will prevent freezing. The freezing point of a battery electrolyte varies with the specific gravity. If extra acid has been added so that the battery, in a state of discharge, has a high specific gravity the freezing point is correspondingly lower, but this introduces other difficulties.

The claim is sometimes made that these solutions and compounds make an old battery work like new. Such a statement is rather vague, but one interpretation which might be placed upon it is the following: If a battery which has been giving less than its rated capacity is treated with such a solution or compound it might be expected that the full rated capacity of the battery would be restored. Experiments have indicated that this is not the case.

The storage battery has a descriptive name because the energy of an electric current supplied to the battery at one time may be held and used at a later time. The chemical reactions which occur in such a battery are reversible. During the charging process the chemical reactions proceed in one direction, while the delivery of electrical energy results from the chemical reactions proceeding in the opposite direction. The fundamental reactions in the battery during discharge result in the formation of lead sulfate at both the positive and negative plates. When the battery is being charged, on the other hand, the lead sulfate is broken down into constituents of the plates and electrolyte. No case has been found in which this fundamental reaction is materially altered by the use of these battery compounds and solutions.

Since the storage battery stores chemical energy rather than electricity as such, the question may be asked how far the chemical reactions may proceed in the battery. Experience shows that, on the average, only 25 to 40 percent of the active materials in the cell are actually used during discharge. A battery which has been discharged, therefore, to a voltage which is below the useful limit can

recuperate to a limited extent if allowed to stand on open circuit for a short time so that the electrolyte has an opportunity to penetrate farther into the pores of the plates and thereby come into contact with active materials which have not been previously converted to lead sulfate. Successive discharges of a battery may be made, therefore, before the battery becomes completely exhausted. Even then much of the original active material still remains. Changing the solution in the battery may permit some further discharge to be made as a result of the fresh solution making contact with active materials already present. This cannot, however, be regarded as evidence that the battery has been charged, because the active materials of the plates have not been restored in any sense of the word.

A battery which is almost completely discharged may have nearly the same voltage as one which is fully charged. In this condition the battery may be able to turn the starter of an automobile or light the lamps, but the exact state of charge can be determined only by making a measured discharge upon it, using suitable measuring instruments.

The lead sulfate which is formed on the plates during the discharge is finely crystallized and quite invisible. If, however, the battery is allowed to stand in an exhausted condition for a considerable period of time the crystals of lead sulfate tend to grow larger and there is also some increase in the amount as a result of local action. In time the plates may become encrusted with a coarsely crystallized lead sulfate which is difficult to break down. The condition of the battery at such a time is not due primarily to the alleged pernicious effects of the sulfuric acid but rather to failure to charge the battery properly. Lead sulfate is sparingly soluble. Introducing a new solution may dissolve a small amount of it, but when the solution becomes saturated with the lead sulfate no more will dissolve.

Analyses of some of the solutions have shown them to contain about 40 percent sulfuric acid and some coloring matter. Other solutions contain about the same amount of sulfuric acid and in addition significant amounts of some or all of the following: Sodium, magnesium, potassium, aluminum, and other less common materials. The sodium, for example, may have been added as soda, lye, or glauber salt, but it seems probable that the metallic ions mentioned above were introduced into the solution in the form of the common sulfate salts, such as glauber salts, epsom salt, and alum.

Battery compounds which are not in liquid form have been found to contain more or less of the materials mentioned above, with the exception of the sulfuric acid. Since the directions for using such compounds ordinarily state that they are to be added to battery electrolytes or to fresh solutions of sulfuric acid, the result in the battery is essentially the same.

The use of sodium sulfate, glauber's salt, in batteries is an old story. It was suggested more than 40 years ago, but various authorities have stated since that time that such a material is without beneficial effect in a battery. The Bureau's recent experiments on the determination of the rate of sulfation of battery plates indicates that even 4 to 5 percent of epsom salt or glauber salts do not materially reduce the rate of sulfation.

The indiscriminate addition of these solutions and compounds to a battery is not advisable, although in some cases no particular harm may be done. If the solution is used to replace the electrolyte of a completely discharged battery, as is frequently the case, the battery may be spurred on to give a little more current because of the surplus of active material in the plates, but when the battery is recharged by an electric current and the lead sulfate in the plates is reconverted into the active materials of the plates and has replenished the electrolyte, the specific gravity will probably rise much above the limitations for good operation. In some of the Bureau's experiments it rose to a specific gravity of 1.365. This is not desirable because the local action or self-discharge within the battery is materially increased. A battery containing one of these solutions lost 47 percent of its charge in 4 weeks as compared with 8 percent which was lost by a similar battery with the ordinary electrolyte. Batteries containing solutions of higher than normal specific gravity may have considerably less capacity at high rates of discharge, as when cranking the engine of an automobile, depending on the behavior of the negative plates. The high specific gravity of the electrolyte is also injurious to the wood separators. It is a well-recognized principle in battery operation that acid should be added only to replace that which has been spilled, or in rare instances to adjust the specific gravity to the required standard after the completion of a full charge.

EXHIBIT 4

BATTERY ADDITIVES

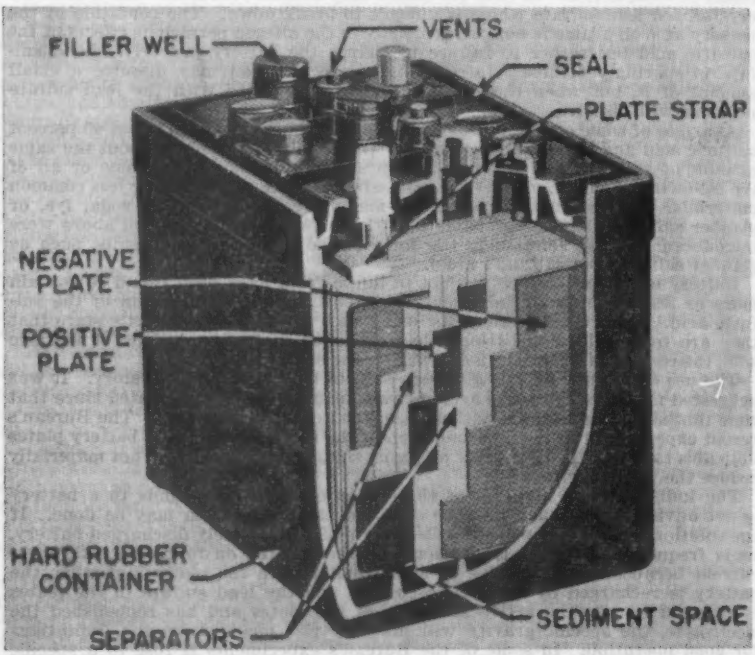
(By Paul L. Howard and George W. Vinal)

National Bureau of Standards Circular 504—Issued January 10, 1951

Various preparations of liquids and solids have been sold to the public as means of rejuvenating worn-out or so-called dead batteries. The majority of these materials are composed of varying proportions of magnesium sulfate and sodium sulfate. Extensive laboratory and field tests have been made covering various proportions of magnesium and sodium sulfates. The results show no difference between the batteries treated with these mixtures and similar untreated batteries used as control.

I. GENERAL DESCRIPTION OF LEAD-ACID STORAGE BATTERY

Figure 1 shows a cutaway view of an ordinary automobile battery. Three cells are housed in a hard-rubber or composition container and covered with



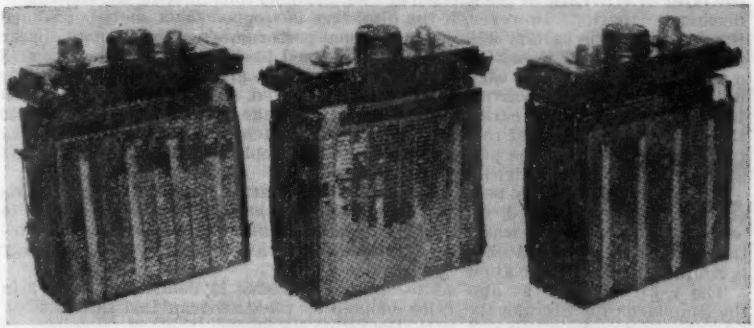
tops of similar material containing filler wells, vents,[1] and terminals. The top is sealed with a bituminous material to complete the battery enclosure. Each cell is composed of several positive and negative plates separated by a wood or microporous separator. Raised partitions in the bottom of the container leave a space under the plates for sediment to collect during the useful life of the battery.

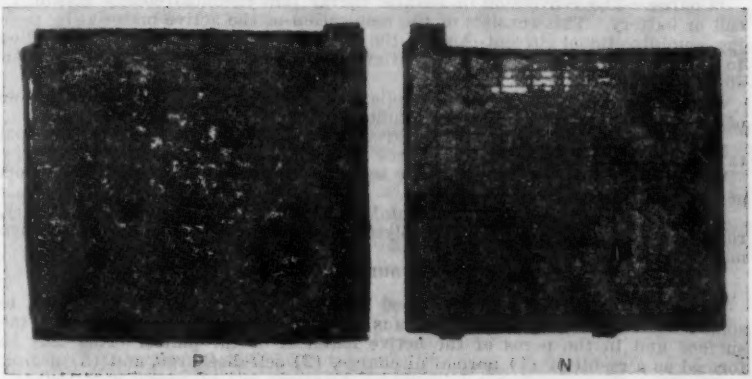
The positive plate is composed of a lead-alloy grid into which lead oxides are pasted and the whole formed electrolytically so that the oxides are converted to lead dioxide. Similarly, the negative plate consists of an alloy grid into which lead oxides are pasted and the whole formed electrolytically so

[1] Sometimes the vents are in the filter caps.

that the oxides are converted to sponge lead. The electrolyte consists of a water solution of sulfuric acid that has a specific gravity in the charged state of about 1.28 when used as an automobile battery.

Figure 1 gives a general picture of a battery at the beginning of its normal life. Figure 2 shows the condition of a battery at the end of its useful life. At that time the positive plates are corroded and the outer grid frame ruptured.





Similarly, the negative plates have lost some of their active material and are badly sulfated. The wood separators are charred by the sulfuric acid, and active material is deposited on their surfaces. Figure 3 shows the condition of the positive plates and negative plates. The positive grid frame is corroded to such an extent that the plate is disintegrated. The negative plate has lost some of its active material in the sulfated area.

II. FUNDAMENTAL FACTS ABOUT STORAGE BATTERIES

A storage battery may be considered as an electrochemical apparatus in which electric energy is stored as chemical energy.

When a storage battery is discharged the chemical energy is transformed into electric energy as the lead dioxide and sponge lead react with the sulfuric acid to form lead sulfate at both the positive and negative plates. The current flows from the positive to the negative plate externally and from the negative to the positive plate internally to complete the cycle of transformation of chemical energy into electric energy.

The lead sulfate formed during the discharge forms a surface coating over most of the surface of each particle of finely divided sponge lead or lead dioxide. The center of the particle, being nonporous, is not converted to lead sulfate. Each particle is in intimate contact with the next particle so that electrically continuous flow of current is maintained. Thus this normal deposit of lead sul-

fate forms a relatively thin film over the particles of active material and is easily reconverted to the corresponding lead or lead dioxide during subsequent recharge. The relative size of these particles determines the amount of electrolyte that may be in the pores of the plate at any given time.

If a battery is subjected to a high rate of discharge, the reaction of the lead and lead dioxide with sulfuric acid will be very rapid. This tends to weaken the layer of acid close to the surface of each particle, thus limiting the continuous discharge capacity. However, if the discharge is stopped for a short period and then repeated, the battery will give additional performance. Thus it may appear to the layman as if it has automatically charged itself. This may be repeated a number of times with each succeeding discharge, giving poorer performance until the battery is effectively completely discharged. This phenomenon, which has been known for 70 years, is inherent in all storage batteries and is known as the recuperative power of the lead-acid battery. Each time the battery is rested the acid diffuses into the pores of the plate and replenishes the supply of acid at the surface of the particles of active material.

After the battery has been discharged it is charged by forcing an electric current in the opposite direction so that the lead sulfate is converted back to lead dioxide and sponge lead according to its original condition. This completes the cycle in which chemical energy furnishes electric energy and electric energy is again stored as chemical energy.

The word "charge" as applied to storage batteries is defined as follows in the Standards for Storage Batteries adopted by the American Institute of Electrical Engineers, dated June 22, 1922 (Definition No. 36–250):

"Charge.—The conversion of electric energy into chemical energy within the cell or battery. This consists of the restoration of the active material by passing a unidirectional current through the cell or battery in the opposite direction to that of the discharge. A cell or battery which is said to be 'charged' is understood to be fully charged."

All the processes described above follow the fundamental electrochemical laws of Faraday, which may be stated as follows:

1. The quantity of a substance set free at an electrode is directly proportional to the quantity of electricity that passes through the solution.

2. The same quantity of electricity sets free the same number of equivalents of substances at the electrodes.

These laws govern the fundamental reactions within the storage battery, regardless of minor changes in electrolyte brought about by the addition of foreign matter.

III. SULFATION

The term "sulfation" has been used in several senses, and this has lead to some confusion. In general, it means the formation of lead sulfate on the surface and in the pores of the active material of the plates. This may be formed as a result of (1) normal discharge, (2) self-discharge, and (3) neglect or abuse.

Sulfation occurring during a normal discharge results in a fine crystalline coating over the particles of active materials. This product is easily reconverted by the charging current. This type of sulfation is a necessary part of the operation of a battery and is not a source of trouble.

The self-discharge type of sulfation is caused by parasitic currents or by the action of the acid on the substances present. The rate at which this sulfation proceeds depends upon the temperature and concentration of the electrolyte. The formation of lead sulfate in this manner is much slower than by the normal discharge process. This allows larger crystals to form. However, if the battery is not neglected, these also will be easily reconverted to active material by the charging current. For an ordinary automobile battery the average loss in charge (as indicated by specific-gravity change) for different temperatures may be given as 0.003 drop per day at 100° F., 0.002 drop per day at 80° F., 0.0005 drop per day at 50° F.

Thus if an 0.075 drop is allowed, the battery would need recharging as a result of local action at the following intervals: At 100° F. recharge at 25 days, at 80° F. recharge at 37 days, and at 50° F. recharge at 5 months. Certain impurities in the electrolyte will increase the local action and hence the rate of sulfation in the plates.

The third and popular use of the word sulfation applies to excessive amounts of lead sulfate that may form in or on the plates as a result of neglect or abuse, as

1. Allowing the battery to stand in a discharged condition for a long time.

2. Neglecting to make repairs when evidence of trouble within the cells becomes apparent.
3. Filling cells with electrolyte when water should have been used.
4. Operating battery at excessive temperatures.
5. Persistent undercharging.
6. Presence of certain impurities in the electrolyte.
7. Operation for long periods in a partially charged condition.

This type of sulfation is more difficult to reduce and may injure the plates. Excessive sulfation can be avoided with reasonable care. It is doubtless true that the liability to troublesome sulfation of lead batteries has been exaggerated by those exploiting so-called cures.

When a battery stands in a discharged condition for some time the lead sulfate crystals tend to grow. In doing this they harden and become larger and may break away from the surface. Also, the growth of the sulfate crystals tends to block the pores of the plate. As these crystals occupy more space than the original active material, their expansion may eventually either fracture the grid frame or loosen the active material.

Lead sulfate is very slightly soluble in sulfuric acid electrolyte at normal temperatures. However, the solubility increases with rise in temperature. One cause of crystal growth depends on a rise in temperature to dissolve the lead sulfate and a drop in temperature to recrystallize it. Thus the larger crystals grow at the expense of the smaller. Another cause is the removal of acid from the electrolyte in the pores as lead sulfate is formed, causing a greater solubility of the lead sulfate in the low gravity acid and a recrystallization as more acid diffuses into the pores or as the amount of electrolyte in the pores is reduced due to growth of the crystals. Both of these causes contribute to troublesome sulfation.

Because of the closing of the pores in the active material by the crystal growth of the lead sulfate it becomes increasingly difficult for the electrolyte to penetrate into the plates. If a battery which has stood for a long time is filled with water and placed on charge with a direct-current source it is found that the initial closed-circuit voltage is much in excess of its normal value. As the electrolyte penetrates into the active material and reconversion begins the voltage will gradually drop to that of a normal cell. If the applied voltage is low and the cell resistance is high, the indications might be that the cell is dead. However, if sufficient time is allowed, there would be a gradual breakdown of active material and current would begin to flow. This condition is true, regardless of whether or not a battery has been treated with additives, provided it has been in a sulfated condition for a long period.

IV. TYPES OF ADDITIVES

More than 100 additives have been brought to the Bureau's attention during the past 30 years. A statement entitled "Solutions do not charge storage batteries" was issued in the Bureau's Technical News Bulletin 94, February 10, 1925. Since that time many additional tests on solutions and compounds, the latter in the form of salts to be added to the battery electrolyte, have been made. Bureau Letter Circular 302 was issued in 1931 and has been revised to meet new demands.

Various types of additives have been marketed over the period of years. Analysis of these preparations shows their composition falls into the following categories:

Solids

(1) Preparations of varying proportions of magnesium sulfate and sodium sulfate in various states of hydration.

(2) Preparations including potassium, aluminum, calcium, or ammonium sulfates, or the corresponding phosphate salts.

(3) In addition to the compounds in (1) and (2), nitrates, chlorides, iron, copper, or mercury may be present. All these are definitely harmful to the battery.

Liquids

(1) Solutions of sulfuric acid of various specific gravities, with or without some coloring matter.

(2) Solutions of sulfuric acid of various specific gravities, with additions of significant amounts of materials containing some or all the following metal ions: sodium, magnesium, potassium, aluminum, and other common materials.

(3) Tapwater with a little organic dye and traces of metal salts.

(4) Tapwater with significant amounts of organic acids or metallic salts of these acids.

(5) Glycerin or alcohol in water solution with or without metal sulfates added.

In general, the directions for using additives specify that each cell of the battery be treated with the contents of a package, filled with water, and charged by means of the automobile generator for a certain length of time. Then a specified test is usually given in which the starter motor drains the battery until it will no longer turn the motor. Then after a rest period the ignition is turned on and the starter will usually turn the motor over long enough to start it.

Such tests are not indicative of the condition of the battery or whether the additive improved the characteristics of the battery, but are calculated to give the unwary purchaser a false idea that an improvement has been caused by the additive. Preliminary tests are essential in order to determine any improvement in performance resulting from the treatment.

In order to make a comprehensive and complete study of the effect of various additives on a battery, a complete check on the characteristics of the battery must be made before and after treating to establish a valid comparison. Referring back to the types of additives listed above, certain conclusions may be drawn from earlier work.

1. In all cases where sulfuric-acid solutions are concerned it is known that no long-term advantage is to be gained through increasing the specific gravity of the electrolyte. Momentarily there may be an increase in capacity, but the increased local action associated with the higher specific gravity will soon overcome this advantage.

2. Use of water with traces of other materials shows no advantage over using plain tapwater to fill the battery. If glycerin or alcohols are present, these are considered harmful as they are converted to harmful organic acids that may remain in the electrolyte and shorten the life of the positive plate.

3. The use of materials containing copper, mercury, iron, nitrates, or chlorides is definitely harmful, as shown in the work of Vinal and Schramm[2] and others.

4. Of all the types listed, the most commonly used materials are magnesium sulfate and sodium sulfate. Combinations of these substances are most commonly used in present-day additives.

V. EXPERIMENTAL PROCEDURE

In order to study these combinations it was necessary to devise a test procedure that would cover the main characteristics of the battery and the claims most often used by the manufacturers for their additive. A series of tests was set up to cover the following points:

1. Change in specific gravity of solution produced by the additive.

2. Effect on capacity at normal discharge rates, such as the 5-hour rate, to determine whether there was a decrease in sulfation.

3. Effect on self-discharge or local action as an indication of improvement in retention of charge.

4. Effect on temperature of cells during charge as a means of prolonging life.

5. Effect on water consumption as an indication of whether the battery was taking the charge better with or without the treatment.

6. Simulation of an operational test where the batteries remained just under full charge for a long period but never on a complete discharge cycle to determine whether the treated cells would recharge more completely than untreated cells.

7. High-rate discharges starting at 300 amperes, then reducing to 200 amperes and 100 amperes successively, to determine whether there is any change in cell performance under these conditions by treating the battery with additives.

Six batteries of Army 6-volt type 2H that had stood for 4 years in a charged and damp condition were filled with 1.050 acid and given a 388 ampere-hour charge. The results of this charge are shown in table 1. Here the specific gravity did not rise equally in all cells and the capacity was low except in battery 5. This battery recovered all its rated capacity but was high in local action.

Capacity and stand loss were measured on these batteries to establish their characteristics prior to treating. A series of combinations of anhydrous magnesium and sodium sulfates were set up as shown in table 2. Mixtures A and C are commercial products, while mixtures B, D, and E were prepared and included in the group in order to extend the range of compositions studied.

[2] Transactions of the American Institute of Electrical Engineers, 44: 288 (1925).

8. Determination of the recuperative power of a cell when subjected to 300-ampere load for a short interval followed by a rest period and repetition of the cycle. This is to indicate whether any improvement was made by the treatment.

9. Effect of several complete cycles to see if there was an increase in capacity and specific gravity.

In order to make such a series of tests it was first necessary to obtain mechanically sound batteries that were permanently sulfated. Various so-called sulfated batteries were obtained and given a charge for an extended period until there was no further change in gravity. A battery made in 1920 that had been allowed to stand from then until 1949 was dismantled and the negative plates charged in 1.050 specific gravity sulfuric acid against sheet-lead positives. These plates were completely converted to sponge lead. It has been the experience here that most of the so-called sulfated batteries filled with low-gravity sulfuric acid or water will respond to normal charging procedures, provided the charge is slow and over an extended period. However, if the cells are filled with high-gravity acid, the response to charge is very poor.

TABLE 1.—*Unused 2H batteries stored damp for 4 years, filled with sulfuric acid of specific gravity 1.050 and charged at 5 amperes for 838 ampere-hours*

Battery No.	Final specific gravity at 28° C. of cell—		
	1	2	3
1	1.268	1.248	1.243
2	1.268	1.268	1.243
3	1.253	1.253	1.268
4	1.258	1.258	1.268
6	1.273	1.263	1.253
5	1.288	1.288	1.288

TABLE 2.—*After preliminary tests, 2 cells in batteries, 1, 2, 3, 4, and 6 of table 1 treated with various mixtures of magnesium sulfate and sodium sulfate*

[Percentages are of the anhydrous salts. Differences from 100 percent indicate the percentage of water of hydration]

Treatment mixture	Battery	Cells treated	Sodium sulfate (Na_2SO_4)	Magnesium sulfate ($MgSO_4$)	Weight of dry mixture
			Percent	*Percent*	*g*
A	1	1 and 3	[1] 68	[1] 15	9.7
B	2	2 and 3	50	30	17
C	3	2 and 3	[1] 42	[1] 45	21
D	4	1 and 2	20	60	18
E	6	2 and 3	10	80	20

[1] Approximate.

Batteries were treated as indicated in table 2. In all cases 1 cell in each battery was used as standard, and the other 2 were treated. The results of these tests are given in tables 4 to 38.

A number of statements have been made over the years to the effect that there is little or no change in gravity when these materials are added to the electrolyte. In order to show the effect on specific gravity, the test mixtures in table 2 were dissolved in 200 milliliters of water, and the specific gravity of each was determined. The results are given in table 3. This volume is approximately 50 percent of the free electrolyte per cell in an automobile storage battery, so the immediate rise in specific gravity approximates 0.015 for every 10 g of additive. However, this rise in gravity is much smaller at the end of a full charge due to complete mixing of the electrolyte.

Tables 4, 5, 6, 7, and 8 show the capacity variations at the 20-ampere rate when discharged immediately after charge and after a 16-hour stand before and after treatment. In practically every case the capacity decreased after treatment more than average. This definitely shows that there is no improve-

ment of cell performance obtained by the use of such additives and further confirms the fact that such additives do not remove the products of sulfation. If the sulfate was removed from the plates, there would have been a marked increase in the capacity of the treated cells. This is not the case. In all cases it is seen that there is no significant difference between treated and untreated cells.

TABLE 3.—*Specific gravity of solutions of the treatment mixtures listed in table 2 in 200 milliliters of water at 24° C.*

Treatment mixture	Dry weight	Specific gravity
	g	
A	9.7	1.036
B	17	1.066
C	21	1.063
D	18	1.062
E	20	1.054

TABLE 4.—*Ampere-hour capacity at the 20-ampere rate before and after treating battery 1 with mixture A*

Cell	Treatment	Temperature	Time	Ampere-hour capacity	
				Freshly charged	After 16-hour stand
		°C			
1	Untreated	33	Initial	56	
	do	28			33
	Treated	33	4 cycle	36.6	
	do	25			28.6
	do	33	6 months	5.0	
2	Untreated	33	Initial	72.6	
	do	28			46.6
	do	33	4 cycle	66.4	
	do	28			53.0
	do	33	6 months	12.6	
3	Untreated	33	Initial	50	
	do	28			36
	Treated	33	4 cycle	46	
	do	28			37.6
	do	33	6 months	11.6	

TABLE 5.—*Ampere-hour capacity at the 20-ampere rate before and after treating cells 2 and 3 of battery 2 with mixture B*

Cell	Treatment	Temperature	Time	Ampere-hour capacity	
				Freshly charged	After 16-hour stand
		°C			
1	Untreated	33	Initial	98.4	
	do	28			95.6
	do	33	4 cycle	83.6	
	do	28			82.0
	do	33	6 months	19	
2	do	33	Initial	76.6	
	do	28			57.2
	Treated	33	4 cycle	63.9	
	do	28			52.6
	do	33	6 months	8.0	
3	Untreated	33	Initial	84.4	
	do	28			66.6
	Treated	33	4 cycle	95.6	
	do	28			83.4
	do	33	6 months	69.6	

TABLE 6.—*Ampere-hour capacity at the 20-ampere rate before and after treating cells 2 and 3 of battery 3 with mixture C*

Cell	Treatment	Temperature	Time	Ampere-hour capacity	
				Freshly charged	After 16-hour stand
		°C			
1	Untreated	33	Initial	70.4	
	do	28			57.6
	do	33	4 cycle	71.4	
	do	28			61.0
	do	33	6 months	22.6	
2	Untreated	33	Initial	52.4	
	do	28			45.4
	Treated	33	4 cycle	47.0	
	do	28			40.0
	do	33	6 months	9.4	
3	Untreated	33	Initial	14.4	
	do	28			15.2
	Treated	33	4 cycle	14.4	
	do	28			11.0
	do	33	6 months	6.0	

TABLE 7.—*Ampere-hour capacity at the 20-ampere rate before and after treating cells 1 and 2 of battery 4 with mixture D*

Cell	Treatment	Temperature	Time	Ampere-hour capacity	
				Freshly charged	After 16-hour stand
		°C.			
1	Untreated	33	Initial	53.6	
	do	28			46.0
	Treated	33	4 cycle	46.4	
	do	28			40.6
	do	33	6 months	13.4	
2	Untreated	33	Initial	90.0	
	do	28			78.4
	Treated	33	4 cycle	71.6	
	do	25			66.4
	do	33	6 months	10	
3	Untreated	33	Initial	97.0	
	do	28			97.2
	do	33	4 cycle	89.0	
	do	28			86.4
	do	33	6 months	8.6	

Tables 9, 10, 11, 12, and 13 summarize the 3- and 4-day stand on open circuit before and after treatment. The stand loss is directly related to retention of charge and is usually a measure of local action. There is no significant difference between treated and untreated cells.

Tables 14, 15, 16, 17, and 18 summarize tests of successive discharges made by starting at 300 amperes and reducing the current to 200 and then to 100 amperes to determine any benefits of treating. It is shown that there is no significant difference in performance of the treated and untreated cells.

Tables 19, 20, 21, 22, and 23 give a record of final cell temperatures for eight charges spread over a 3-month period. It might be noted that cell 2 is a center cell, which, because of its protected position normally runs 0.5 to 1° C. higher. There is no significant difference in temperature between treated cells during this period.

TABLE 8.—*Ampere-hour capacity at the 20-ampere rate before and after treating cells 2 and 3 of battery 6 with mixture E*

Cell	Treatment	Temperature	Time	Ampere-hour capacity	
				Freshly charged	After 16-hour stand
		°C			
1	Untreated	33	Initial	85.4	
	do	28			75.6
	do	33	4 cycle	68.0	
	do	28			60.0
	do	33	6 months	4.0	
2	Untreated	33	Initial	31.4	
	do	28			30.0
	Treated	33	4 cycles	27.4	
	do	28			22.4
	do	33	6 months	5.0	
3	Untreated	33	Initial	30.6	
	do	28			30.0
	Treated	33	4 cycles	27.6	
	do	28			22.0
	do	33	6 months	6.0	

Tables 24, 25, 26, 27, and 28 summarize the water consumption over a 6-month period. The first part covered cycle operation during tests of cell characteristics. The remaining period covered a simulated life test. There is no significant difference in water consumption between treated and untreated cells. An overall average per week shows a loss of 59 milliliters of water for the treated and 58 milliliters of water for the untreated cells for the 27-week period.

Tables 29, 30, 31, 32, and 33 give the variations in specific gravity over a 26-week period of simulated life test where the battery is maintained just under full charge. In this case the loss in charge was due to excessive local action. The variation is about the same order, whether the cells are treated or untreated. After the 26 weeks, a freshening charge was given to determine the ability of the batteries to return to initial conditions. Here again, the untreated cells performed as well as the treated cells.

TABLE 9.—*Drop in specific gravity during 3- and 4-day stands before and after treating cells 1 and 3 of battery 1 with mixture A*

Cell	Treatment	Following cycle—	Total drop in specific gravity at 28° C.		
			Time	3-day stand	4-day stand
1	Untreated	1		0.028	
	do	2			0.044
	Treated	3		.043	
	do	4			.049
	do		6 months		.049
2	Untreated	1		.033	
	do	2			.042
	do	3		.033	
	do	4			.059
	do		6 months		.044
3	Untreated	1		.033	
	do	2			.042
	Treated	3		.038	
	do	4			.059
	do		6 months		.039

TABLE 10.—*Drop in specific gravity during 3- and 4-day stands before and after treating cells 2 and 3 of battery 2 with mixture B*

Cell	Treatment	Following cycle—	Total drop in specific gravity at 28° C.		
			Time	3-day stand	4-day stand
1	Untreated	1		0.023	
	do	2			0.042
	do	3		.038	
	do	4			.054
	do		6 months		.019
2	Untreated	1		.028	
	do	2			.047
	Treated	3		.043	
	do	4			.049
	do		6 months		.039
3	Untreated	1		.033	
	do	2			.042
	Treated	3		.038	
	do	4			.049
	do		6 months		.039

TABLE 11.—*Drop in specific gravity during 3- and 4-day stands before and after treating cells 2 and 3 of battery 3 with mixture C*

Cell	Treatment	Following cycle—	Total drop in specific gravity at 28° C.		
			Time	3-day stand	4-day stand
1	Untreated	1		0.033	
	do	2			0.037
	do	3		.028	
	do	4			.044
	do		6 months		.044
2	Untreated	1		.028	
	do	2			.042
	Treated	3		.043	
	do	4			.044
	do		6 months		.044
3	Untreated	1		.033	
	do	2			.042
	Treated	3		.043	
	do	4			.039
	do		6 months		.039

TABLE 12.—*Drop in specific gravity during 3- and 4-day stands before and after treating cells 1 and 2 of battery 4 with mixture D*

Cell	Treatment	Following cycle—	Total drop in specific gravity at 28° C.		
			Time	3-day stand	4-day stand
1	Untreated	1		0.043	
	do	2			0.042
	Treated	3		.053	
	do	4			.044
	do		6 months		.039
2	Untreated	1		.038	
	do	2			.042
	Treated	3		.038	
	do	4			.029
	do		6 months		.049
3	Untreated	1		.028	
	do	2			.027
	do	3		.033	
	do	4			.029
	do		6 months		.039

TABLE 13.—*Drop in specific gravity during 3- and 4-day stands before and after treating cells 2 and 3 of battery 6 with mixture E*

Cell	Treatment	Following cycle—	Total drop in specific gravity at 26° C.		
			Time	3-day stand	4-day stand
1	Untreated	1		0.038	
	do	2			0.037
	do	3		.023	
	do	4			.034
	do		6 months		.034
2	Untreated	1		.038	
	do	2			.047
	Treated	3		.033	
	do	4			.044
	do		6 months		.039
3	Untreated	1		.038	
	do	2			.047
	Treated	3		.038	
	do	4			.039
	do		6 months		.039

TABLE 14.—*300, 200, 100 ampere successive constant-current discharge of battery 1 after treating cells 1 and 3 with mixture A*

Current (amperes)	Time of discharge	Cell 1, treated	Cell 2, untreated	Cell 3, treated
	Minutes	*Volts*	*Volts*	*Volts*
300	0.5	1.14	1.37	1.27
	1.0	.95	1.29	1.18
	1.5	.55	1.17	1.03
	2.0	0	1.02	.85
	2.5	−.8	.87	.62
	3.0	−.125	.65	.3
200	3.0			
	[1] 3.5	−.96	.80	.5

[1] After the 3.5-minute reading, cell 1 began to smoke so discharge was discontinued.

TABLE 15.—*300-, 200-, 100-ampere successive constant-current discharge of battery 2 after treating cells 2 and 3 with mixture B*

Current (amperes)	Time of discharge	Cell 1, untreated	Cell 2, treated	Cell 3, treated
	Minutes	*Volts*	*Volts*	*Volts*
300	Start	1.60	1.50	1.68
	1.0	1.60	1.46	1.67
	2.0	1.54	1.27	1.63
	3.0	1.49	1.04	1.62
200	3.0			
	3.5	1.62	1.24	1.72
	5.0	1.60	1.15	1.71
	7.0	1.52	.60	1.68
	7.5	1.49	.40	1.67
100	7.5			
	8.0	1.69	1.00	1.78
	10.0	1.69	.88	1.78
	15.0	1.63	.32	1.76
	20.0	1.48	−.45	1.69

TABLE 16.—*300-, 200-, 100-ampere successive constant-current discharge of battery 3 after treating cells 2 and 3 with mixture C*

Current (amperes)	Time of discharge	Cell 1, untreated	Cell 2, treated	Cell 3, treated
	Minutes	*Volts*	*Volts*	*Volts*
300	Start	1.53	1.29	0.96
	0.5	1.48	1.21	.40
	1.0	1.46	1.10	−1.05
	1.0			
200	1.25	1.61	1.33	−1.00
	2.00	1.58	1.23	−1.40
	2.3			
100	2.4	1.78	1.62	0
	2.5	1.77	1.57	−0.65

TABLE 17.—*300-, 200-, 100-ampere successive constant-current discharge of battery 4 after treating cells 1 and 2 with mixture D*

Current (amperes)	Time of discharge	Cell 1, treated	Cell 2, treated	Cell 3, untreated
	Minutes	*Volts*	*Volts*	*Volts*
300	Start	1.4	1.47	1.59
	0.5	1.29	1.44	1.58
	1.0	1.18	1.37	1.56
	2.0	.70	1.20	1.51
	2.5	.35	1.07	1.49
	2.5			
200	2.75	.68	1.32	1.64
	3.0	.60	1.29	1.62
	3.5	.32	1.25	1.62
	4.0	0	1.21	1.61
	4.0			
100	4.25	.85	1.56	1.77
	5.0	.83	1.565	1.78
	10.0	.13	1.44	1.74
	11.0	−.02	1.41	1.74

TABLE 18.—*300-, 200-, 100-ampere successive constant-current discharge of battery 6 after treating cells 2 and 3 with mixture E*

Current (amperes)	Time of discharge	Cell 1, untreated	Cell 2, treated	Cell 3, treated
	Minutes	*Volts*	*Volts*	*Volts*
300	Start	1.49	1.21	1.13
	0.5	1.43	1.03	.98
	1.0	1.36	.64	.60
	1.25	1.33	0	0
	1.25			
200	1.5	1.50	.67	.72
	2.0	1.47	.34	.43
	2.33	1.47	0	.13
	2.33			
100	2.5	1.68	.76	.90
	3.0	1.69	.69	.84
	5.0	1.65	.16	.38
	7.0	1.60	−.40	−.18
	8.0	1.57	−.57	−.38

TABLE 19.—*Cell temperatures at end of charge before and after treating cells 1 and 3 of battery 1 with mixture A*

Charge	Input	Finishing rate	Temperature of cell—				
			1		2	3	
			Untreated	Treated	Untreated	Untreated	Treated
	Ampere-hours	*amperes*	*° C.*	*° C.*	*° C.*	*° C.*	*° C.*
1	388	5	32.5		33.5	32.5	
2	248	5	31.5		32	32	
3	339	5	31		32	31	
4	194	5		35	35		35
5	130	10		38.5	39		38.5
6	145	10		34	35		35
7	135	5		31	31		31
8	120	5		37	37.5		37

TABLE 20.—*Cell temperatures at end of charge before and after treating cells 2 and 3 of battery 2 with mixture B*

Charge	Input	Finishing rate	Temperature of cell—				
			1, Untreated	2		3	
				Untreated	Treated	Untreated	Treated
	Ampere-hours	*Amperes*	*° C.*	*° C.*	*° C.*	*° C.*	*° C.*
1	388	5	33	33.5		33.5	
2	248	5	32	32.5		32	
3	339	5	31	32		31.5	
4	194	5	33.5		34		33.5
5	130	10	36		36.5		36
6	145	10	34		34.5		35
7	135	5	31		31		31
8	120	5	38.5		39		39

TABLE 21.—*Cell temperatures at end of charge before and after treating cells 2 and 3 of battery 3 with mixture C*

Charge	Input	Finishing rate	Temperature of cell—				
			1, Untreated	2		3	
				Untreated	Treated	Untreated	Treated
	Ampere-hours	*Amperes*	*° C.*	*° C.*	*° C.*	*° C.*	*° C.*
1	388	5	33	33.5		33	
2	248	5	32	32.5		32	
3	339	5	31	31.5		31	
4	194	5	33.5		34		33.5
5	130	10	38.5		39		38.5
6	145	10	34.5		35.5		35.5
7	135	5	32.5		32		32
8	120	5	39		39		39

TABLE 22.—*Cell temperature at end of charge before and after treating cells 1 and 2 of battery 4 with mixture D*

Charge	Input	Finishing rate	Temperature of cell—				
			1		2		3, untreated
			Untreated	Treated	Untreated	Treated	
	Ampere-hours	*Amperes*	*° C.*	*° C.*	*° C.*	*° C.*	*° C.*
1	388	5	32.5	----------	33.5	----------	33.5
2	248	5	32.0	----------	32.5	----------	32.5
3	339	5	31.0	----------	32.0	----------	31.0
4	194	5	----------	33.0	----------	34.0	33.5
5	130	10	----------	38.0	----------	39.0	38.0
6	145	10	----------	34.0	----------	35.0	35.0
7	135	5	----------	31.5	----------	32.0	31.5
8	120	5	----------	39.0	----------	39.0	39.0

TABLE 23.—*Cell temperature at end of charge before and after treating cells 2 and 3 of battery 6 with mixture E*

Charge	Input	Finishing rate	Temperature of cell—				
			1		2		3, untreated
			Untreated	Treated	Untreated	Treated	
	Ampere-hours	*Amperes*	*° C.*	*° C.*	*° C.*	*° C.*	*° C.*
1	388	5	33.5	33.5	----------	33.0	----------
2	248	5	32.5	32.5	----------	32.0	----------
3	339	5	31.5	32.0	----------	31.5	----------
4	194	5	33.5	----------	34.5	----------	33.5
5	130	10	38.5	----------	40.5	----------	39.5
6	145	10	35.0	----------	35.0	----------	34.0
7	135	5	32.0	----------	31.0	----------	31.0
8	120	5	39.0	----------	38.0	----------	38.0

TABLE 24.—*Water consumption of battery 1 over a 27-week period after treating cells 1 and 3 with mixture A*

Time (weeks)	Cycle condition (daily)	Water consumption by—		
		Cell 1, treated	Cell 2, untreated	Cell 3, treated
		Milliliters	*Milliliters*	*Milliliters*
Start	Cycled	144	90	75
3	do	150	218	220
9	4-hour charge, 20-hour stand	350	317	327
16	do	522	497	475
22	do	320	242	275
27	do	240	214	224
Total, milliliters		1,726	1,573	1,521
Average water per week, milliliters		64	58	56

TABLE 25.—*Water consumption of battery 2 over a 27-week period after treating cells 2 and 3 with mixture B*

Time (weeks)	Cycle condition (daily)	Water consumption by—		
		Cell 1, untreated	Cell 2, treated	Cell 3, treated
		Milliliters	*Milliliters*	*Milliliters*
Start	Cycled	95	75	95
3	do	171	174	162
9	4-hour charge, 20-hour stand	312	330	296
16	do	440	459	392
22	do	324	303	261
27	do	211	230	214
Total, milliliters		1,553	1,571	1,420
Average water per week, milliliters.		57	58	53

TABLE 26.—*Water consumption of battery 3 over a 27-week period after treating cells 2 and 3 with mixture C*

Time (weeks)	Cycle condition (daily)	Water consumption by—		
		Cell 1, untreated	Cell 2, treated	Cell 3, treated
		Milliliters	*Milliliters*	*Milliliters*
Start	Cycled	145	70	80
3	do	139	213	228
9	4-hour charge, 20-hour stand	329	329	336
16	do	493	477	483
22	do	301	303	296
27	do	228	226	260
Total, milliliters		1,635	1,618	1,683
Average water per week, milliliters.		60	60	62

TABLE 27.—*Water consumption of battery 4 over a 27-month period after treating cells 1 and 2 with mixture D*

Time (weeks)	Cycle condition (daily)	Water consumption by—		
		Cell 1, treated	Cell 2, treated	Cell 3, untreated
		Milliliters	*Milliliters*	*Milliliters*
Start	Cycled	80	90	90
3	do	220	191	209
9	4-hour charge, 20-hour stand	327	340	272
16	do	502	483	488
22	do	308	305	276
27	do	243	250	232
Total, milliliters		1,660	1,659	1,567
Average water per week, milliliters.		61	61	58

TABLE 28.—*Water consumption of battery 6 over a 27-week period after treating cells 2 and 3 with mixture E*

Time (weeks)	Cycle condition (daily)	Water consumption by—		
		Cell 1, untreated	Cell 2, treated	Cell 3, treated
		Milliliters	*Milliliters*	*Milliliters*
Start	Cycled	85	70	60
3	do	207	233	228
9	4-hour charge, 20-hour stand	306	324	318
16	do	453	450	482
22	do	302	283	297
27	do	231	204	238
Total, milliliters		1,584	1,564	1,623
Average water per week, milliliters		58	58	60

TABLE 29.—*Specific gravity of battery 1 after treating cells 1 and 3 with mixture A, placed on a cycle of 4-hour charge at 5 amperes and 20-hour stand per day, 7 days per week for 26 weeks*

Time (weeks)	Specific gravity at 28° C.					
	Cell 1, treated		Cell 2, untreated		Cell 3, treated	
	Cycle	Full charge	Cycle	Full charge	Cycle	Full charge
Start		1.253		1.243		1.248
6	1.242	1.250	1.227	1.250	1.217	1.245
12	1.232		1.217		1.202	
20	1.212	1.228	1.202	1.223	1.192	1.218
26	1.202	1.224	1.192	1.219	1.177	1.204
Loss:						
Cycle	.040		.035		.040	
Full charge		.029		.024		.044

TABLE 30.—*Specific gravity of battery 2 after treating cells 2 and 3 with mixture B, placed on a cycle of 4-hour charge at 5 amperes and 20-hour stand per day, 7 days per week for 26 weeks*

Time (weeks)	Specific gravity at 28° C.					
	Cell 1, untreated		Cell 2, treated		Cell 3, treated	
	Cycle	Full charge	Cycle	Full charge	Cycle	Full charge
Start		1.258		1.272		1.253
6	1.242	1.255	1.272	1.280	1.242	1.255
12	1.222		1.262		1.232	
20	1.207	1.229	1.252	1.264	1.222	1.234
26	1.197	1.224	1.247	1.264	1.222	1.234
Loss:						
Cycle	.045		.025		.020	
Full charge		.034		.008		.019

TABLE 31.—*Specific gravity of battery 3 after treating cells 2 and 3 with mixture C, placed on a cycle of 4-hour charge at 5 amperes and 20-hour stand per day, 7 days per week for 26 weeks*

Time (weeks)	Specific gravity at 28° C.					
	Cell 1, untreated		Cell 2, treated		Cell 3, treated	
	Cycle	Full charge	Cycle	Full charge	Cycle	Full charge
Start		1.253		1.258		1.268
6	1.247	1.260	1.237	1.255	1.242	1.260
12	1.232		1.222		1.227	
20	1.212	1.234	1.212	1.239	1.222	1.234
26	1.212	1.234	1.207	1.229	1.212	1.234
Loss:						
Cycle	0.035		0.030		0.030	
Full charge		0.019		0.029		0.034

TABLE 32.—*Specific gravity of battery 4 after treating cells 1 and 2 with mixture D, placed on a cycle of 4-hour charge at 5 amperes and 20-hour stand per day, 7 days per week for 26 weeks*

Time (weeks)	Specific gravity at 28° C.					
	Cell 1, treated		Cell 2, treated		Cell 3, untreated	
	Cycle	Full charge	Cycle	Full charge	Cycle	Full charge
Start		1.255		1.265		1.260
6	1.242	1.260	1.252	1.265	1.272	1.275
12	1.222		1.232		1.262	
20	1.217	1.234	1.222	1.239	1.250	1.259
26	1.207	1.234	1.222	1.239	1.232	1.254
Loss:						
Cycle	.035		.030		.040	
Full charge		.021		.026		.006

TABLE 33.—*Specific gravity of battery 6 after treating cells 2 and 3 with mixture E, placed on a cycle of 4-hour charge at 5 amperes and 20-hour stand per day, 7 days per week for 26 weeks*

Time (weeks)	Specific gravity at 28° C.					
	Cell 1, untreated		Cell 2, treated		Cell 3, treated	
	Cycle	Full charge	Cycle	Full charge	Cycle	Full charge
Start		1.272		1.279		1.259
6	1.277	1.285	1.242	1.260	1.242	1.260
12	1.267		1.227		1.227	
20	1.252	1.259	1.212	1.229	1.212	1.229
26	1.242	1.254	1.202	1.224	1.202	1.224
Loss:						
Cycle	0.035		0.040		0.040	
Full charge		0.018		0.035		0.035

Tables 34, 35, 36, 37, and 38 show the results of short high rate discharges with rest periods in between. It must be pointed out that open-circuit voltages are essentially normal after each cycle. Particular attention is called to the last cycle where the immediate open-circuit voltages are given showing the recuperative power of the battery. The results again show no significant difference between treated and untreated cells. The tests outlined above were on unused batteries sulfated from long wet shelf life.

An additional test was carried out on a used 6-volt, 100 ampere-hour automobile battery which would not hold its charge. Characteristics of this battery were determined before treatment and again after treating cells 2 and 3 with mixture C of table 2. Table 39 summarizes the 300-, 200-, 100-, and 50-ampere constant-current successive discharge before and after treatment. The battery then stood 16 hours, and the same discharge was repeated. It was found that 200 amperes was the highest current that could be maintained. A careful survey of this table shows there is a voltage rise each time the current is reduced. This shows the remarkable recuperative power of a battery regardless of its condition, provided it is mechanically sound. As seen here, there is no significant improvement in the treated cells. For a good battery the voltage should be near 2 volts and not reversed. Table 40 summarizes the stand characteristics of the same battery. Again, there was no improvement shown in its ability to retain a charge.

TABLE 34.—*Test on recuperative power of battery 1 after cells 1 and 3 were treated with mixture A when subjected to a 300-ampere constant-current load for 1 minute followed by 15 minutes on open circuit and the cycle repeated*

Cycle	Discharge time	Cell 1, treated		Cell 2, untreated		Cell 3, treated	
		Open circuit	Closed circuit	Open circuit	Closed circuit	Open circuit	Closed circuit
	Minutes	*Volts*	*Volts*	*Volts*	*Volts*	*Volts*	*Volts*
		2.08		2.08		2.08	
1	Start		1.05		1.30		1.20
	0.5		.6		1.14		1.05
	1.0		−.2		1.00		.88
		2.03		2.03		2.02	
2	Start		.5		1.10		.9
	0.5		(1)		1.06		1.02
		2.03		2.03		2.02	
3	Start		0		1.00		1.00
Final open circuit		2.03		2.02		2.02	

[1] Reversed.

TABLE 35.—*Test on recuperative power of battery 2 after cells 2 and 3 were treated with mixture B when subjected to a 300-ampere constant-current load for 2 minutes followed by 15 minutes on open circuit and the cycle repeated*

Cycle	Time	Cell 1, untreated		Cell 2, treated		Cell 3, treated	
		Open circuit	Closed circuit	Open circuit	Closed circuit	Open circuit	Closed circuit
	Minutes	*Volts*	*Volts*	*Volts*	*Volts*	*Volts*	*Volts*
		2.08		2.08		2.08	
1	Start		1.50		1.34		1.65
	0.5		1.44		1.23		1.64
	1.0		1.40		1.04		1.62
	1.5		1.32		.66		1.61
	2.0		1.23		.20		1.60
		2.03		2.06		2.04	
2	Start		1.36		.94		1.63
	0.5		1.20		−.60		1.6
	1.0		1.06		−1.00		1.56
		2.03		2.06		2.04	
3	Start		1.30		.40		1.60
	0.5		1.03		−1.09		1.56
Immediate		1.96		1.68		2.0	
15 minutes		2.03		2.05		2.03	

TABLE 36.—*Test on recuperative power of battery 3 after cells 2 and 3 were treated with mixture C when subjected to a 300-ampere constant-current load followed by 15 minutes on open circuit with cycle repeated*

Cycle	Time	Cell 1, untreated		Cell 2, treated		Cell 3, treated	
		Open circuit	Closed circuit	Open circuit	Closed circuit	Open circuit	Closed circuit
	Minutes	*Volts*	*Volts*	*Volts*	*Volts*	*Volts*	*Volts*
		2.08		2.08		2.08	
1	Start		1.44		1.06		0.72
	0.5		1.30		.74		−.2
		2.05		2.04		2.03	
2	Start		1.34		.80		0
	0.3		1.28		.50		−.8
		2.05		2.03		2.03	
3	.1		1.3		.2		−1.10
Immediate		2.01		2.0		1.90	
15 minutes		2.04		2.03		2.03	

TABLE 37.—*Test on recuperative power of battery 4 after cells 1 and 2 were treated with mixture D when subjected to a 300-ampere constant-current load followed by 15 minutes on open circuit with cycle repeated*

Cycle	Time	Cell 1, treated		Cell 2, treated		Cell 3, untreated	
		Open circuit	Closed circuit	Open circuit	Closed circuit	Open circuit	Closed circuit
	Minutes	*Volts*	*Volts*	*Volts*	*Volts*	*Volts*	*Volts*
		2.08		2.08		2.08	
1	Start		1.26		1.22		1.43
	0.5		1.08		1.02		1.39
	1.0		.82		.72		1.32
		2.03		2.05		2.07	
2	Start		1.04		.84		1.36
	.5		.54		−.10		1.26
		2.03		2.05		2.07	
3	Start		.82		.40		1.30
	.5		.20		−.24		1.24
Immediate		1.86		1.78		2.03	
15 minutes		2.02		2.03		2.06	

TABLE 38.—*Test on recuperative power of battery 6 after cells 2 and 3 were treated with mixture E when subjected to a 300-ampere constant-current load followed by 15 minutes on open circuit with cycle repeated*

Cycle	Time	Cell 1, untreated		Cell 2, treated		Cell 3, treated	
		Open circuit	Closed circuit	Open circuit	Closed circuit	Open circuit	Closed circuit
	Minutes	*Volts*	*Volts*	*Volts*	*Volts*	*Volts*	*Volts*
		2.08		2.08		2.08	
1	Start		1.24		1.24		0.92
	0.5		1.04		.66		.62
	0.75		.86		.30		.30
		2.07		2.03		2.03	
2	Start		1.05		.50		.40
		2.07		2.03		2.03	
3	Start		1.00		.32		.32
	0.5		.86		0		.10
Immediate		1.94		1.84		1.86	
15 minutes		2.07		2.03		2.03	

TABLE 39.—*Results of 300-, 200-, 100-, and 50-ampere successive discharges on a discarded 6-volt automobile battery that would not hold its charge, before treatment and after treating cells 2 and 3 with mixture C*

Current	Time of discharge	Cell 1, untreated		Cell 2		Cell 3	
		Before	After	Before treatment	After treatment	Before treatment	After treatment
	Minutes	*Volts*	*Volts*	*Volts*	*Volts*	*Volts*	*Volts*
	Start	1.63		1.60		1.63	
Amperes	0.5	1.61	1.56	1.55	1.58	1.61	1.58
	1.5	1.55	1.48	1.45	1.50	1.55	1.40
300	2.0	1.51	1.40				
	2.5			1.22	1.29	1.45	1.34
	3.0	1.40	1.33	1.00	1.20	1.25	1.19
	3.5						
200	3.75	1.60	1.50	1.24	1.27	1.59	1.40
	4.0		1.50	.6	.6		1.35
	4.25						
100	4.5	1.74	1.70	1.18	.4	1.74	1.62
	5.0		1.69	−.2	(1)		1.62
	5.0						
	5.1	1.90	1.81	1.44	1.24	1.90	1.79
50	6.0	1.82	1.80	.55	−.1	1.82	1.76
	10.0	1.81	1.78	−.47	−.5	1.81	1.74
	16	1.77		−.41		1.77	
	Repeat discharge after overnight stand						
200	0.25	1.52	1.48	−1.05	−1.00	1.44	1.43
	.25						
100	.75		1.66		−.6		1.58
	.75						
50	1.00		1.77		−.45		1.72
	2.00		1.76		−.45		1.71

[1] Revised.

TABLE 40.—*Results of stand test on a discarded 6-volt automobile battery before and after treating cells 2 and 3 with mixture C*

Time	Drop in specific gravity at 28° C.					
	Cell 1, untreated		Cell 2		Cell 3	
	Initial	Final	Before treatment	After treatment	Before treatment	After treatment
Days						
3	0.024	0.050	0.194	0.209	0.030	0.060
7	.049	.084	.194	.219	.060	.094

As a further study of the possible effect of various mixtures of magnesium and sodium sulfates on self-discharge, tests were made on negative plates taken from a discarded battery. These plates were charged in sulfuric acid of specific gravity 1.050 against pure-lead positives. After charge they were placed horizontally in tanks of sulfuric acid of specific gravity 1.350 and inverted glass tubes closed at the top and initially completely filled with acid were placed over portions of the plates to collect the gas given off in a 24-hour period. Then the plates were taken out and recharged in sulfuric acid of specific gravity 1.275 with the various mixtures of magnesium and sodium sulfates outlined in table 41 and the test repeated. The amount of gas collected is an indication of the local action on the plate. Table 41 gives a summary of the results. There is no significant reduction in local action due to treatment with magnesium or sodium sulfates.

TABLE 41.—*Measurement of gas evolution from negative plates on 24-hour stand in sulfuric acid of specific gravity 1.350 before and after treating with mixtures of sodium sulfate and magnesium sulfate*

Plate [1]	Anhydrous material in 30 g of material		Milliliters of gas from portions of plates—			
			Upper		Lower	
	Sodium sulfate	Magnesium sulfate	Before treatment	After treatment	Before treatment	After treatment
	Percent	*Percent*				
1	None	None	75.6	74.9	14.4	20.2
2	None	None	27.2	30.0	29.0	34.9
3	80	20	79.1	82.0	10.4	15.4
4	80	20	30.0	69.0	20.8	22.9
5	60	40	70.3	45.5	20.0	16.3
6	60	40	26.0	39.0	12.8	18.6
7	40	60	50.5	35.0	20.3	18.4
8	40	60	71.8	54.2	20.0	31.9
9	20	80	77.7	88.0	41.8	55.8
10	20	80	51.0	51.5	24.2	27.4
11	None	100	45.4	45.5	21.1	20.6
12	100	None	71.2	73.0	23.7	30.6

[1] Plates 5, 7, 8, upper sections badly sulfated. Did not recharge during treatment.

Another series of tests was carried out by storing batteries for a period of 1 year and then reservicing them. These batteries were reserviced as follows: Filled with sulfuric acid of specific gravity 1,280, treated with a commercial preparation of magnesium and sodium sulfate, treated with a saturated water solution of sodium sulfate, and treated with a saturated water solution of magnesium sulfate. A summary of the results is given in figures 4, 5, and 6.

Figure 4 gives variation in capacity at the 5-hour rate. This shows the stand- and procedure of filling with acid is superior. Similarly, figure 5 shows the 5-minute rate, and figure 6 the cycle life. In all cases there is no improvement shown by the use of combinations of magnesium and/or sodium sulfate.

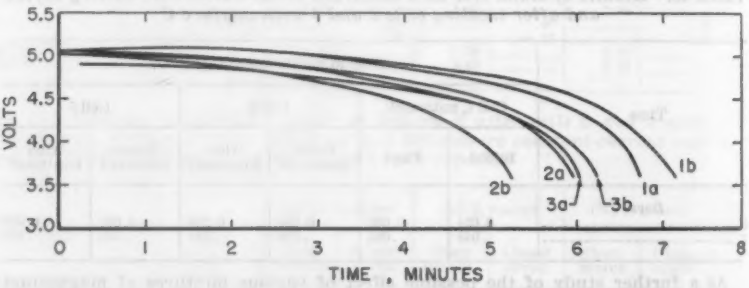


FIGURE 4.—*Capacities of batteries stored 1 year reserviced, both treated and untreated, discharged at the 5-hour rate*

Cell	Composition of additive			Time of treatment
	Na_2SO_4	$MgSO_4$	H_2O	
	Percent	*Percent*	*Percent*	
1a				Not treated.
1b				Do.
2a	44.2	29.3	25.8	Before storage.
2b	44.2	29.3	25.8	After storage.
3a	(1)			Do.
3b		(1)		Do.

[1] Saturated solution.

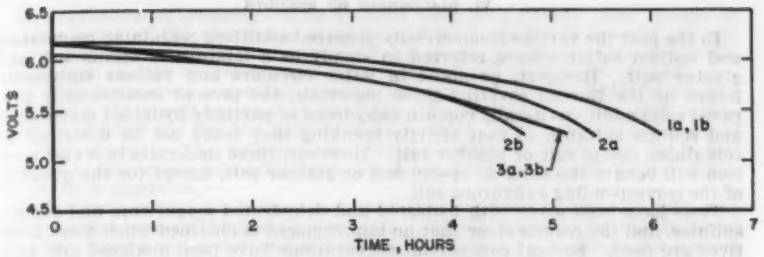


FIGURE 5.—*Capacities of batteries stored 1 year reserviced, both treated and untreated, discharged at the 5-minute rate*

Cell	Composition of additive			Time of treatment
	Na_2SO_4	$MgSO_4$	H_2O	
	Percent	*Percent*	*Percent*	
1a				Not treated.
1b				Do.
2a	44.2	29.3	25.8	Before storage.
2b	44.2	29.3	25.8	After storage.
3a	(1)			Do.
3b		(1)		Do.

[1] Saturated solution.

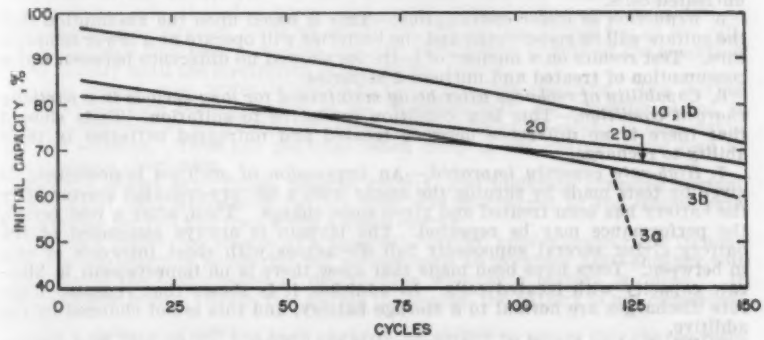


FIGURE 6.—*Capacities of batteries stored 1 year reserviced, both treated and untreated, during cycle life discharged at 5-hour rate*

Cell	Composition of additive			Time of treatment
	Na_2SO_4	$MgSO_4$	H_2O	
	Percent	*Percent*	*Percent*	
1a				Not treated.
1b				Do.
2a	44.2	29.3	25.8	Before storage.
2b	44.2	29.3	25.8	After storage.
3a	(1)			Do.
3b		(1)		Do.

[1] Saturated solution.

VI. DISCUSSION OF RESULTS

In the past the various commercially prepared additives containing magnesium and sodium sulfates were referred to simply as a mixture of epsom salt and glauber salt. However, as noted in letter circulars and various statements issued by the Bureau covering these materials, the present commercially prepared solid additives usually contain anhydrous or partially hydrated magnesium and sodium sulfates, so that strictly speaking they could not be described as containing epsom salt or glauber salt. However, these materials in water solution will behave the same as epsom salt or glauber salt, except for the quantity of the corresponding anhydrous salt.

Tests have been made with hydrated and dehydrated magnesium and sodium sulfates, and the results show that no improvement is obtained when these additives are used. Several commercial preparations have been analyzed and used to fill in the percentage range covered. In no case has there been any improvement in battery performance.

The investigation has covered the following subjects, which are usually set up as claims for additives:

1. *Change in specific gravity.*—There is an increase in specific gravity proportional to the amount of increase in sulfate ion.

2. *Reduction or elimination of troublesome sulfation.*—True indication of this would be found in a marked improvement in capacity at normal discharge rates. Increases in specific gravity after charge must be greater than the increase which is directly ascribable to addition of the additive itself. Tests have now shown neither of these to be increased.

3. *Retention of charge.*—For a battery to show an improvement in retention of charge there must be a reduction in self-discharge and/or local action. Tests show no evidence of such a reduction.

4. *Reduced operating temperatures.*—In order to lower the operating temperature of a sulfated battery there must be a reduction of sulfate in the plates. There has been no significant difference in temperature between treated and untreated cells.

5. *Reduction in water consumption.*—This is based upon the assumption that the sulfate will be reconverted and the batteries will operate at a lower temperature. Test results on a number of batteries showed no difference between water consumption of treated and untreated batteries.

6. *Capability of recharge after being maintained for long periods in a partially charged condition.*—This is a condition conducive to sulfation. Tests showed that there is no difference between treated and untreated batteries in their ability to recharge.

7. *High-rate capacity improved.*—An impression of such an improvement is given by tests made by turning the motor with a battery-operated starter after the battery has been treated and given some charge. Then, after a rest period, the performance may be repeated. The layman is always astounded at the battery giving several supposedly full discharges with short intervals of rest in between. Tests have been made that show there is no improvement in high-rate capacity with treated cells. In addition, it is shown that repeated high-rate discharges are normal to a storage battery, and this is not changed by the additive.

8. *Effect of cycle.*—Some proponents of the additives claim no effect will be shown by cycling a battery, whereas others say it takes a number of cycles to show an improvement. Tests showed that there is no improvement by cycling over that normally obtained in untreated batteries. Tests on a schedule simulating car operation have been made, and the results show no difference between treated and untreated batteries.

9. *Prolonged battery life.*—This is rather vague as battery life depends largely on conditions of use. Many batteries are discarded or replaced prematurely. If batteries are checked and any mechanical defects corrected as required by the manufacturers of the additives, they will give additional life without the use of additives. In other cases the discarded batteries may show conditions as indicated in figures II and III. It is obvious that such batteries cannot be helped or the life prolonged by the use of additives.

10. *Prevention of freezing.*—This is often used as a claim. Any change in freezing point of the electrolyte must be due to a change in specific gravity. At any temperature where the battery will operate the starter the specific gravity will be high enough to prevent freezing whether or not an additive is used.

11. The statements regarding making lights brighter and spark hotter are misleading. It is well known that the lights will become brighter at high engine speeds and after the car has been running a while, even though the battery is not fully charged. The voltage and current furnished to both the lights and ignition system come primarily from the generator and not the battery while the car is in operation.

The layman is told his battery is "dead" when it fails to perform. No real definition has been established for this term. Some mechanics use a hydrometer reading, others a cell tester and still others resort to a quick charge for a short interval and then use either the hydrometer or cell tester to determine the condition of the battery.

Without a full knowledge of battery principles, either the hydrometer readings or cell tester may lead to erroneous conclusions. Let us consider two conditions that may be present, i. e. (1) a battery with sufficient electrolyte to measure, (2) a battery with the electrolyte level below the tops of plates.

In the first case, the battery is in a discharged condition but has sufficient electrolyte to obtain hydrometer readings. If this battery is placed on charge at a high rate for approximately 30 minutes, there will be very little change in hydrometer readings. This condition is common in storage-battery operation and should not be construed to mean that the battery is not taking the charge. When a discharged battery is first placed on charge most of the electric energy is used to convert the lead sulfate to active material and sulfuric acid. As there is practically no gas evolution there is no stirring action present to mix the sulfuric acid formed at the surface of the plates with the rest of the electrolyte of lower specific gravity. Consequently, the sulfuric acid streams down the surface of the plate and settles to the bottom, because it is heavier than the remainder of the electrolyte. It may take some time for sufficient gas to be developed to stir the electrolyte enough to form a homogenous solution. Hydrometer readings are made on samples of electrolyte at the top of the cell. It is easily seen that such a reading does not show a true picture of the condition of the battery until the electrolyte is thoroughly mixed.

In the second case, water is added to the cell before charging. The mixing of the water with the electrolyte is not complete until the charging period is almost completed, at which time gas evolution is sufficiently strong to thoroughly mix the solution. Thus any readings taken early in the charge would lead to an erroneous conclusion.

Figure 7 shows the voltage, specific gravity, and high-rate charging current on a normal 108-ampere-hour battery that was discharged at the 6-hour rate to 1.70 volts per cell and then given a quick charge.

Placing a battery on charge at a constant current, approximating the 20-hour rate, and periodically measuring the voltage with an accurate 1,000-ohm-per-volt voltmeter is the best method of determining whether a battery is "dead." If there is a continuous voltage rise during the charge, the battery is not considered dead.

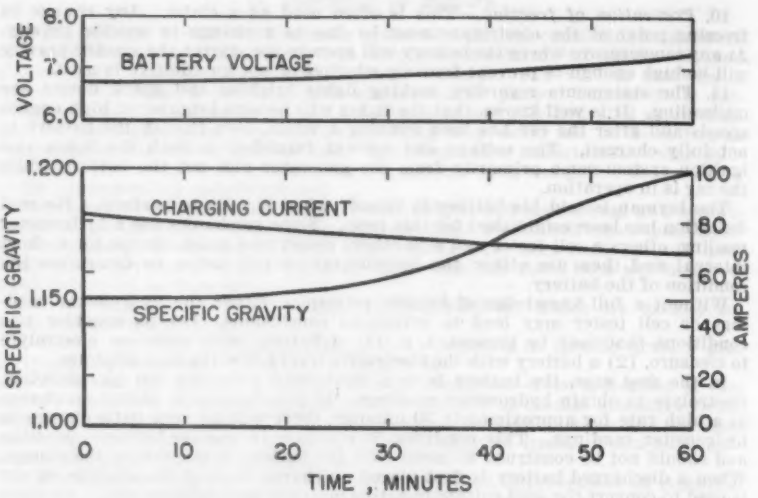
After a battery or cell has been charged, its ability to retain this charge rests upon its mechanical and chemical condition. If there is an internal short, the cell will lose its charge rapidly. If there is high local action, the same thing will be true. In either case the use of additives has shown no beneficial effects.

In a large percentage of the procedures used in adding additives to discarded batteries two conditions are included, i. e.:

1. The battery is nearly dry and needs a large amount of water to bring the level over the top of the plates.

2. There are mechanical defects that must be repaired by dismantling the battery and either replacing separator or plates and generally disturbing the equilibrium of the system.

As discussed earlier, the water treatment is the procedure long recognized as best adapted to the removal of substantial portions of the sulfate from the plates.



In the first case, this essentially resolves itself into such a treatment. The end result will be the same with or without the additive.

In both cases, air has had an opportunity to play a part in the overall reaction. In item (2), particularly, the plates are exposed to air. In such cases some oxidation is taking place that changes the composition of the plate to a mixture of lead oxides and sulfate. In general, after a repair operation the plates are more easily converted to lead and lead dioxide. The addition of water or low-gravity sulfuric acid is normal procedure. Thus the battery responds equally well with or without any additives. In such a procedure the battery is charged at the 20-hour rate for approximately 50 hours.

VII. FIELD TESTS

The above results and discussions are based on simulated tests made in the laboratory. As a further check on the correctness of these tests, actual field tests were carried out by the Ordnance Corps, Department of the Army, on 200 automotive batteries at various depots throughout the country. These four groups of batteries were all mechanically sound and in various stages of life, as follows: (1) 50 batteries ready for salvage, (2) 50 batteries still in service, (3) 50 batteries new but never put in service, and (4) 50 batteries new but never put in service.

The batteries in groups (1), (2), and (3) were treated with mixture C, and those in group (4) were tested as controls. Monthly checks were made to determine the condition of the batteries. The results of these checks are given in tables 42, 43, and 44. Table 42 summarizes the failures, table 43 gives variation in specific gravity, and table 44 summarizes the results as to satisfactory performance. From these tests it was concluded that there were no beneficial effects gained by using mixture C.

TABLE 42.—*Number of failures out of 50 batteries in each group when treated with mixture C and field tested for 6 months*

Battery condition	Months						Total percentage of failure
	1	2	3	4	5	6	
							Percent
Mechanically sound, but ready for salvage (treated)	4	12	3	2	2	0	46
Mechanically sound and still in service (treated)	2	4	3	0	0	4	26
New batteries never prepared for service (treated)	0	1	1	1	1	0	8
New batteries never prepared for service (untreated)	0	0	0	0	1	0	2

TABLE 43.—*Percentage variation in specific gravity at end of 6-month period on batteries treated with mixture C*

	Group 1, treated	Group 2, treated	Group 3, treated	Group 4, untreated
	Percent	*Percent*	*Percent*	*Percent*
Increase	34	32	35	40
Same	24	23	21	19
Lower	42	45	44	41

TABLE 44.—*Percentage of satisfactory and unsatisfactory batteries after inspection at 6-month period on batteries still in service*

Condition	Group 1, treated	Group 2, treated	Group 3, treated	Group 4, untreated
	Percent	*Percent*	*Percent*	*Percent*
Satisfactory	47	45	64	75
Unsatisfactory	53	55	36	25

VIII. CONCLUSIONS

In the course of this investigation 5 batteries comprising 15 cells were subjected to an extended series of laboratory tests to determine the effect of adding specified amounts of sodium and magnesium sulfates in varying proportions. These batteries were in sound mechanical condition but were sulfated to the extent that their initial capacity after prolonged charging was about two-thirds of their rated capacity. Ten cells were treated with additives, and the remaining five were not treated.

Tables 4 to 31 show no significant differences in the operating characteristics of the cells that were treated as compared with those not treated. Obviously, the condition of a group of batteries in a sulfated state is not uniform, but the average results of 15 cells covering all tests show a remarkable uniformity in the behavior of treated and untreated cells. The averages are given in table 45.

It appears from table 45 that both sodium and magnesium sulfates are ineffective in improving the condition of the batteries or in prolonging their life.

TABLE 45.—*Average results of all tests, tables 4 to 31*

	Untreated cells	Treated cells
Capacity rating	120 ampere-hour	120 ampere-hour.
Initial capacity, all cells	64 ampere-hour	
Initial capacity of treated cells:		
Before treatment	54 ampere-hour	
After treatment		48 ampere-hour.
Final capacity after 6 months:		
Untreated cells	13 ampere-hour	
Treated cells		14 ampere-hour.
Voltage at 1 minute, per cell, 300-ampere load	1.45 volts	1.12 volts.
Recuperative voltage per cell, 1 minute after 300-ampere load	2.04 volts	2.03 volts.
Water consumption during 27-week test, per cell	58 ml/week	59 ml/week.
Decrease in specific gravity during 4-day stand	0.006	0.007.
Points lost at full charge during cycle test, 26 weeks	0.020	0.028.
Cell temperature at end of 8th charge	39.0° C.	38.4° C.

From the extensive laboratory and field tests covered in this investigation the fact remains that there has been no improvement found in the use of a series of commercial and specially prepared additives composed of magnesium and sodium sulfates either hydrated, partially hydrated, or anhydrous.

The indiscriminate addition of these solutions and compounds to a battery is not advisable, although in some cases no particular harm may be done. It is a well-recognized principle in battery operation that acid should be added only to replace that which has been spilled or, in rare instances, to adjust the specific gravity to the required standard after the completion of a full charge. Materials containing iron, copper, mercury, nitrates, chlorides, glycerin, or alcohols should never be added to batteries as they will cause permanent damage to the battery.

The findings reported here are not confined to the Bureau's experience. Investigations by other laboratories, both Government and industrial, have arrived at similar conclusions on the various points discussed in this publication.

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WASHINGTON, August 4, 1950.

EXHIBIT 5

[Press release TRG–6116, U. S. Department of Commerce, National Bureau of Standards, E. U. Condon, Director]

BATTERY ADDITIVES

Results of extensive study of popular battery restorers, claimed to rejuvenate wornout automotive storage batteries, have just been released by the National Bureau of Standards. Many of these preparations are being sold daily with the promise that if used in a new, failing, or dead battery, the useful life of the battery can be greatly increased. The Bureau has tested most of these additives for the Federal Government and found them of no value. In fact, there seems to be no difference between the life of "doped" batteries and untreated batteries used as a control.

The primary components of a lead-acid storage battery such as ordinarily used on an automobile are positive plates composed of lead dioxide; negative plates of sponge lead; separators of wood or other porous material; an electrolyte consisting of a sulfuric acid-water solution; and a hard-rubber container. During the normal discharge process sulfation occurs resulting in a fine crystalline coating over the pores of the chemically active material. This type of sulfation, however, is a necessary part of the operation of a battery and is not a source of trouble. Excessive sulfation, such as caused by disuse, undercharging, high-temperature operation, or general neglect, results in lower output of the battery and also less capacity for recharging.

Battery additives are usually composed of varying proportions of magnesium sulfate and sodium sulfate. In addition they sometimes contain nitrates, chlorides, iron, copper, or mercury which are definitely harmful to the battery. These additives supposedly remove the excess sulfation from the battery plates—a process which would necessarily take place by proper charging of the battery.

But as the important factors concerning battery operation as the consumer sees it are the length and quality of service that can be obtained and not what happens to the battery inside, the Bureau's electrochemistry laboratory devised several tests to determine certain characterisitics of battery operation that would be indicative of good service. Any changes in properties such as specific gravity, capacity, self-discharge, cell temperature, water consumption, high-rate discharge, and recuperative power were noted. The batteries did not seem to be affected either favorably or adversely by the addition of any of these additives.

The results of the Bureau's studies have been published in Circular 504, Battery Additives, which may be obtained from the Superintendent of Documents, United States Government Printing Office, Washington 25, D. C., for 15 cents a copy.

EXHIBIT 6

NATIONAL BUREAU OF STANDARDS, UNITED STATES DEPARTMENT OF COMMERCE

Washington 25, D. C., April 1951

TECHNICAL REPORT 1537

BATTERY ADDITIVES

Recent investigations by P. L. Howard and G. W. Vinal, of the National Bureau of Standards, have shown that battery additives—preparations frequently sold with claims that they will rejuvenate dead batteries—in fact have no effect on battery life or performance. Extensive laboratory tests[1] simulating actual service conditions were made on a wide variety of commercial additives. The results show no significant difference between the batteries treated with these mixtures and similar untreated batteries used as controls.

During the last 30 years, more than 100 different battery additives, both powders and solutions, have appeared on the market. Most of the solutions have consisted of sulfuric acid, sometimes with additions of sodium sulfate, magnesium sulfate, or coloring matter. In connection with a broad program of research on the properties of batteries, the Bureau investigated the liquid preparations several years ago and found that they produced no essential difference in the charging, voltage, efficiency, or operating temperature of a battery. Today, however, most of the common additives consist of combinations of magnesium and sodium sulfates in various states of hydration. The present investigation was therefore concentrated on these substances as representative of the powdered additives.

In general, the directions for using the additives specify that each cell of the battery be treated with the contents of the package, filled with water, and charged by means of the automobile generator for a certain length of time. A test is usually specified in which the starter motor drains the battery until it will no longer turn the motor; then, after a rest period, the ignition is turned on, and the starter will usually turn the motor over long enough to start it. Although untreated batteries can be expected to react in the same way to such a test, the purchaser is likely to believe that an improvement has been caused by the additive.

Obviously, a more objective method for determining the effect of the additives on battery performance was required. The Bureau therefore developed a series of simulated service tests designed to cover the principal characteristics of a battery and the claims most often made for the additives. To establish a valid basis of comparison between the treated and untreated batteries, a complete check was made on the characteristics of the batteries studied, both before and after treatment.

Five 3-cell batteries of the Army 6-volt type 2H that had stood for 4 years in a charged and damp condition were filled with sulfuric acid of specific gravity 1.050 and given a 388-ampere-hour charge. The batteries were in sound mechanical condition but, as a result of the deposition of lead sulfate on their plates, their initial capacities after prolonged charging were only about two-thirds of their rated capacity. After measurement of capacity and stand loss, a series of combinations of magnesium and sodium sulfates was made up from representative commercial additives and these combinations were added separately to various test cells of the group of batteries. Two cells in each battery were treated with the sulfates while the third was untreated and used as a standard.

In practically every case, after treatment with the additives the capacity of the treated cells at the normal discharge rate decreased more than that of the control cell. This definitely shows that the use of such preparations does not improve cell performance nor does it remove sulfate from the plates, as has been claimed. If sulfate had been removed from the plates, there would

[1] For further details, see National Bureau of Standards Circular 504, Battery Additives, by Paul L. Howard and George W. Vinal, available from the U. S. Government Printing Office at 15 cents a copy.

have been a marked increase in the capacity of the treated cells. However, there was actually no real difference between the capacities of the treated and untreated cells.

Tests were also made to determine the effect of the additives on local action as indicated by changes in specific gravity during standing. The batteries were kept on open circuit for 3- and 4-day periods both before and after treatment. Specific gravity readings taken during these periods showed that the additives caused no reduction in local action.

Exponents of the solid type of additives usually claim that use of their products results in lower operating temperature and therefore reduced water consumption. This is based on the assumption that the additives will cause a reduction in the lead sulfate deposit on the plates. To investigate this point, the Bureau measured final cell temperatures at the end of a charging period both before and after treatment with the additives. Water consumption was also determined for treated and untreated cells over a 6-month period. In this test also, no significant differences were observed between the treated and untreated cells.

To determine the validity of the test suggested by the additive proponents, in which the treated battery appears to be rejuvenated on standing, the Bureau observed the voltages of both treated and untreated cells when subjected to a short high-rate discharge followed by a rest period. Unused batteries whose plates were sulfated from long wet shelf storage were charged and then subjected to a 300-ampere constant-current load for 1 or 2 minutes followed by a 15-minute rest period on open circuit. Here again, no significant differences were found between the treated and untreated cells. In other words, repeated high-rate discharges after intervals of rest are normal to a storage battery and do not result from use of an additive. Statements made to the effect that use of additives will make lights brigther and the spark hotter are also misleading, as the voltage and current furnished the lights and ignition system come primarily from the generator rather than the battery while the car is in operation. Thus the lights will become brighter at high engine speeds and after the car has been running a while, even though the battery is not fully charged.

Use of an additive may sometimes appear to revive a battery which seems to be dead but actually is not. Often a battery which does not give a satisfactory reading with a hydrometer after a 30-minute high-rate charge is considered incapable of taking a charge. However, hydrometer readings do not give a true picture of the condition of the battery during the initial stages of charging. The sulfuric acid produced in the charging process, because of its greater density, tends at first to settle in the bottom of the cell, where it is not detected by the hydrometer. It is only after considerable gas has been evolved in the charging process that the electrolyte is stirred to the point where it is of uniform density and can give a fair test with a hydrometer. Likewise the cell voltage does not change appreciably until near the end of charge.

To investigate further the possible effect of additives on self-discharge, studies of local action were made on negative plates taken from a discarded battery. The plates were charged against pure-lead positives in sulfuric acid of specific gravity 1.050. After charge they were placed horizontally in tanks of sulfuric acid of specific gravity 1.350, and glass tubes closed at one end were placed over portions of the plates to collect the gas given off in a 24-hour period. Then the plates were taken out and recharged in sulfuric acid of specific gravity 1.275 treated with the various mixtures of magnesium and sodium sulfates, and the test was repeated. Local action, as indicated by the amount of gas collected, was not reduced by treatment with the additives.

In another series of tests, batteries were stored dry for 1 year and then reserviced with different electrolytes. Some were filled with a standard battery solution consisting of sulfuric acid of specific gravity 1.280. Others were filled with acid to which had been added either (1) a commercial preparation of magnesium and sodium sulfate, or (2) a saturated water solution of sodium sulfate, or (3) a saturated water solution of magnesium sulfate. Capacities were measured at the 5-minute and 5-hour discharge rate. In every instance the standard procedure of filling with acid resulted in higher capacities than did the use of combinations of magesium and sodium sulfate with the acid.

The Bureau's laboratory tests were confirmed by field tests carried out independently over a 6-month period by the Ordnance Corps, Department of the Army, on 200 automotive batteries at ordnance depots throughout the country. Two-thirds of the batteries were treated with a mixture of sodium and magnesium sulfate while the remaining third were tested as controls. The condition of the

batteries was checked each month, and at the end of the 6 months the percentage variation in specific gravity and the number of satisfactory batteries in each group were determined. As in the Bureau's studies, the results of these tests showed no benefit from use of the additives.

TABLE 1.—*Average results of the National Bureau of Standards tests on Army 6-volt batteries*

	Untreated cells	Treated cells
Capacity rating	120-ampere hours	120 ampere-hours.
Initial capacity, all cells	64 ampere-hours	
Initial capacity of treated cells:		
Before treatment	54 ampere-hours	
After treatment		48 ampere-hours.
Final capacity after 6 months:		
Untreated cells	13 ampere-hours	
Treated cells		14 ampere-hours.
Voltage at 1 minute, per cell, 300-ampere load	1.45 volts	1.12 volts.
Recuperative voltage per cell, 1 minute after 300-ampere load	2.04 volts	2.03 volts.
Water consumption during 27-week test, per cell	58 milliliters per week.	59 milliliters per week.
Decrease in specific gravity during 4-day stand	0.006	0.007.
Points lost at full charge during cycle test, 26 weeks	0.020	0.028.
Cell temperature at end of 8th charge	39.0 °C	38.4 °C.

EXHIBIT 7

National Bureau of Standards

MEMORANDUM ON BATTERY ADDITIVES

The issuance in January 1951 of National Bureau of Standards Circular 504,[1] Battery additives, has aroused much interest in the automotive field. Not only are genuine requests for information coming in from battery users and from dealers who have been approached as possible distributors, but a number of critical letters have been received from purveyors of these materials. One, at least, agrees with us that his competitors' materials are worthless but each would claim that his own is an exception.

The findings of the National Bureau of Standards indicate: (1) That battery additives are worthless, (2) that no saving of materials results from their use, and (3) that apparent improvement in battery performance and the rejuvenation of dead batteries are entirely unrelated to the use of battery additives. This memorandum explains briefly points (2) and (3), as well as providing information on the NBS position in this type of work. For details as to point (1), refer to NBS Circular 504.[1]

NBS testing

The National Bureau of Standards is the principal agency of the Federal Government for basic and applied research in physics, mathematics, chemistry, and enginering. Insofar as substances like those constituting battery additives are concerned, the National Bureau of Standards is a fact-finding agency. It neither approves nor disapproves proprietary products. NBS Circular 504 specifies no proprietary products. Circulars of this kind constitute summaries of many tests over a long period of time. They are issued to aid Federal agencies, business, and the public and represent an economical method of handling inquiries addressed to the National Bureau of Standards.

NBS does not normally make tests[2] of proprietary products at the request of private individuals or firms because: (1) Such service would be an unwarranted competition with private testing laboratories, (2) because an impossibly large volume of testing work would be demanded if such a service were inaugurated, and (3) because to maintain properly such a service would also require an impossibly large and complex sampling organization to insure

[1] NBS Circular 504, Battery Additives, U. S. Government Printing Office, Washington 25, D. C., 15 cents.

[2] For a detailed statement of NSB test policy and testing and calibration services, see NSB Circular 483, Testing by the National Bureau of Standards, U. S. Government Printing Office, Washington 25, D. C., 25 cents.

that the materials tested were properly representative of the whole national market. On the other hand, NBS frequently makes acceptance tests on materials purchased by the Federal Government for its own use. Usually the results of such tests are reported only to Government agencies concerned.

Battery additive work

As explained in NBS Circular 504, for many years proprietary "dopes" have been offered for sale with the claim that they would improve the performance of lead-acid storage batteries in various ways. Many of these additives are mixtures in different proportions of epsom and glauber salts (magnesium and sodium sulfates). These substances are very well known. Numerous tests, the most recent of which are reported in NBS Circular 504, have shown clearly that these mixtures are of no benefit whatever for batteries. (It is interesting that these substances ordinarily sell for about 22 cents per pound, but when packaged as battery additives, sell for about $20 per pound.)

For more than 20 years, the National Bureau of Standards has received inquiries on battery additives. In 1931 a mimeographed leaflet was prepared in order to reduce the cost of replying to these inquiries. The more comprehensive scientific study reported in NBS Circular 504 represents the culmination of these many years of experience in this field. Each of the nine distinct types of tests there reported was carefully planned to bring out, if it existed, one of the various beneficial effects claimed for these materials, but no benefit was found.

The tests provide unambiguous results. They simulate the conditions met in actual use so that specific field or road tests are not necessary for conclusive findings. One of the tests, for example, is based on a standard test devised by the Society of Automotive Engineers. Test results have been confirmed by other laboratories, including studies by the Department of Defense. For example, the extensive field trials quoted in NBS Circular 504, were made by the Ordnance Corps, Department of the Army, under three different conditions, using the commercial material designated as C.

Additives and battery materials

One argument often advanced by proponents for battery additives is that the use of a really effective additive would cause a national saving of lead which is now in critical supply. Actually when a user purchases a new battery, the old one is almost invariably turned back promptly through the scrap metal market and the lead in it used in the manufacture of new batteries. On the average, over 90 percent of battery lead is thus reclaimed and reused so that this argument would be of little moment even if the additive were effective.

Two characteristics of batteries

At first glance it may appear strange that users of battery additives accept the claims made for them and even supply affidavits attesting to such beliefs. This situation arises because of certain peculiar properties of lead-acid storage batteries.

One peculiarity is that after a battery is apparently exhausted and unable to turn an engine over, and is then left alone for a half an hour, the diffusion of electrolyte in the pores of the plates brings a considerable amount of electrolyte into position with active material for a further discharge. If, in a demonstration, the additive is inserted after the first exhaustion and before the self-recuperation, the additive gets the undeserved credit.

A second peculiarity is that when an exhausted battery is first put on charge the heavy sulfuric acid formed by the charging process tends to settle to the bottom. Hence, the usual test of the top liquid with a hydrometer will show little or no change in specific gravity and may be thought to indicate that the battery "is not taking a charge." After further charging, diffusion, and the stirring by the bubbles evolved when gassing is reached, bring the dense acid to the top where it mixes with the less dense acid and the hydrometer reading then becomes significant. If the additive is added between the two readings, it again gets the undeserved credit.

Battery treatment

Sellers of additives often urge the users to clean, overhaul, or even rebuild their old batteries or to give them controlled cyclic charges when inserting the additive. Such well-known treatments naturally improve the operation, wheth-

er or not the additive is used. The users thus made battery-conscious are less likely to neglect their batteries or to discard them without an effort to reclaim them. Many batteries are discarded and replaced when as much as 20 percent of their initial capacity is still left and can be utilized by careful nursing. This change in practice by the user gives him the better battery service, whether or not he uses the additives.

WASHINGTON, D. C., *August 28, 1953.*

EXHIBIT 8

NATIONAL BETTER BUSINESS BUREAU, INC.,
405 Lexington Avenue, New York, N. Y., August 1950.

BATTERY COMPOUNDS AND SOLUTIONS

(An important statement on the subject of battery additives in general from the National Bureau of Standards, together with that bureau's findings on Battery AD–X2, and the views of the manufacturer of that additive for discounting the National Bureau of Standards' findings)

Because of an increasing number of inquiries on so-called battery dopes, the National Better Business Bureau sought up-to-date information from the National Bureau of Standards on the subject for the information and guidance of the public. It is pleased to quote below an official statement dated March 9, 1949, from Dr. E. U. Condon, Director of the National Bureau of Standards:

"The National Bureau of Standards receives many inquiries about preparations which are said to 'charge' or 'rejuvenate' storage batteries. Over a period of 25 years a large number of such battery additives have been exploited. Some 40 or 50 of these preparations have been tested and analyzed. For the most part these compounds and solutions have as principal ingredients either or both magnesium sulfate and sodium sulfate. In the hydrated condition these are known as epsom salt and glauber salt respectively. They are often used, however, in various lesser states of hydration in which case these common names do not apply. When the salts are dissolved in water solutions, it is immaterial whether hydrated or dehydrated salts are employed, provided the same actual weight of the salt exclusive of its water of hydration is employed. In various samples other constituents were indicated, including aluminum sulfate, potassium sulfate, ammonium sulfate, several kinds of alum, glycerine, chromates, phosphates, sulfuric acid, salts of copper and iron, and organic coloring agents. Whatever effect these materials may have in a storage battery when added to the standard electrolyte for such batteries, this Bureau has never found any evidence that they affect the fundamental electrochemical reactions which occur in the battery when it is charged or discharged.

"Occasionally automotive batteries may need a supplementary charge from an external source of power. This is usually evidence of some maladjustment of the operating conditions. These 'charges' are naturally a source of inconvenience and may be misunderstood by the nontechnical public. Too often these compounds are advertised with claims that the necessity for such charges is eliminated. In any case the supplementary charge, amounting to 100 to 150 ampere hours, is emphasized, forgetting that the generator on the car supplies several thousand ampere-hours to the battery in the course of a year. Advertising leaflets accompanying these compounds are usually careful to specify that the battery and the charging system on the car must be in mechanically good condition before using the material. If this were not so, the shortcomings of the panacea would speedily become apparent.

"It is, of course, possible that some material may eventually be found which would relieve the difficulties arising from abnormal operation of storage batteries, but none of the exploited materials which have been tested here have had any such merits.

"Compounds of epsom salt and/or glauber salt and analogous materials under a seemingly endless variety of trade names, indicating their intended application to batteries, have come and gone without attaining any permanent acceptance by the public or the battery industry.

ADVERTISING CLAIMS

"Advertising leaflets which accompany these compounds often deal in generalities and make few specific claims the correctness of which could be determined without long and expensive tests. These claims usually include such statements as (1) charges battery, (2) reduces sulfation, (3) lessens chance of buckled plates and decreases sludge, (4) increases useful life, (5) helps prevent freezing, (6) retains charge longer, and numerous other statements. Sometimes, simple 'practical tests' are described which may lead to false conclusions by those who are not familiar with the technical aspects of the subject. The ordinary user, of course, cannot compare the efficiencies of similar batteries treated with the material and others not so treated, nor can he determine whether the material extends the useful life of his battery. The usual treatment consists of adding the material to the battery first then letting the motor run for about 20 minutes to 1 hour. As an apparent proof of the merits of the material, the battery is 'run down' by stepping on the starter with switch 'off' until the motor no longer turns over. The battery is then rested for a few minutes, turn the switch 'on' and step on starter. The motor will start as indeed it should.

"This test relies upon the well known recuperative property of storage batteries. The normal battery at high rate discharge only uses a small part of its useful capacity. On standing a short time the battery appears to have regained this capacity, since it will again operate for a short time at high rates. Carefully controlled tests are necessary in order to determine these points definitely and none of these materials which have been tested here have produced any beneficial effect when added to the regular electrolyte. Some are definitely harmful.

"It is still evident that the best electrolyte for a storage battery is that presently used by the battery manufacturers since years of research and experience have shown no other materials superior to the customary sulfuric acid electrolyte of proper specific gravity."

USE VOIDS FACTORY GUARANTY

Battery manufacturers generally sell their products with a standard warranty or guaranty against failure caused by manufacturing defects. This guaranty is voided, manufacturers informed the National Better Business Bureau, by the introduction of any battery dope into their batteries. The reason for this is that many battery compounds contain impurities which are definitely harmful to batteries. Naturally, manufacturers decline any responsibility for damage caused by tinkering with the original electrolyte.

BATTERY AD–X2

Battery AD–X2 is a battery additive manufactured by Pioneers, Inc., of Oakland, Calif. The product is a specially prepared compound of chemicals containing sodium sulfate and magnesium sulfate which according to the manufacturer have been so treated that operating experience has shown the treatment to persist after its addition to the electrolyte of the lead-acid battery. Pioneers, Inc., has taken the position that although the National Bureau of Standards' findings with respect to sodium sulfate and magnesium sulfate battery "dopes," as stated in this bulletin are correct as applied to this class of product, they do not apply to Battery AD–X2. Pioneers, Inc., has had voluminous correspondence with both the National Bureau of Standards and the National Better Business Bureau. The National Bureau of Standards has advised NBBB as follows on April 5, 1950, concerning the applicability of its findings to AD–X2:

"At your request for information relative to this Bureau's work on battery additives and on one known as AD–X2 in particular, it may be stated that the Bureau, for its own information, has made extended experiments recently, the results of which confirm our previous conclusions that magnesium sulfate and sodium sulfate are not effective as alleged in restoring batteries or in prolonging their life. On the basis of these recent experiments we have no reason to modify statements previously made in our Letter Circular 302.

"These experiments were initiated to obtain data on several battery additives at present being sold to the public as well as on a wide range of compositions which the Bureau prepared. AD–X2 was therefore included in these tests. The samples of AD–X2 used in these tests were received from the Better Business Bureau of Oakland, Calif. In the preparation of the report the battery

additives actually used are designated in code. The Bureau was fortunate in procuring a group of batteries in sound mechanical condition but sulfated as a result of long standing. Tests of these extended over 6 months and it is now possible to say that the results show no benefit from the use of these additives, including AD–X2.

"We have also the results of tests made elsewhere on 200 batteries in actual service on automobiles which were treated with AD–X2. A sufficient number of cells in these batteries were kept in the untreated condition for comparison with the results of those treated. Here again the results show no evidence of beneficial effects of AD–X2. We have been informed also of tests in a university laboratory in which AD–X2 has been tested and reported to have no beneficial effect.

"In view of the tests made here and in competent laboratories elsewhere it is our belief that AD–X2 is not essentially different from other preparations containing magnesium sulfate and sodium sulfate, and that as a class these materials are not beneficial. The results of recent tests are being prepared for issuance as a Bureau circular but in the meantime we see no reason to modify Letter Circular 302."

Pioneers, Inc., has expressed the view to NBBB that the above-quoted findings of the National Bureau of Standards should be discounted for the following reasons:

"In the correspondence between us, it has been mentioned many times by both Dr. Randall and ourselves that it is difficult to make a really definitive laboratory test of Battery AD–X2 and that the only practical means of determining the value of the product is through field test.

"As to the field test by the National Bureau of Standards we note that they have definitely stated to you that such a test or tests was made on batteries in actual service. We are well aware of this but as stated to you in previous correspondence these tests were not run in accordance with our specifications and therefore did not indicate the value to be derived from our product.

"* * * that another Government agency has investigated us (Pioneers, Inc.) on our home ground here in Oakland and although no report has been issued by this agency, we are certain that they found our product lived up to all the claims made for it. We think it highly significant that one Government agency which has investigated us (Pioneers, Inc.) and the users of our product finds that the product does what we claim, whereas the National Bureau of Standards finds the product worthless on the basis of tests which we as manufacturers know will prove little, if anything."

EXHIBIT 9

TEST OF A BATTERY ADDITIVE

By the National Bureau of Standards, Washington, D. C., September 5, 1952

SECTION I. SUMMARY

1. Background

During the past 25 years the National Bureau of Standards has investigated the effect of various additives on storage battery operation at the request of various Federal agencies. Because of the large number of inquiries received by the Bureau regarding the effectiveness of battery additives, mimeographed documents, called Letter Circulars, have been issued from time to time as an economical means of handling such correspondence. This material, with the results of a more comprehensive investigation in recent years, was published in NBS Circular 504, *Battery Additives*, issued January 10, 1951. The data presented in this Circular indicate that none of the battery additives that have been examined by the Bureau is of any value. The present report gives the results obtained recently by the Bureau in a further series of tests on a particular battery additive.

2. Test method

The basic test procedure was established by the manufacturer, whose contention it had been that the Bureau's prior investigation did not constitute adequate testing of his product. The general characteristics of this test were as follows (see Section II for details): shelf-sulfated batteries in good mechnical condi-

tion were to be used; half were to be treated with the manufacturer's battery additive while half were to remain untreated, serving as controls; a prescribed charging procedure was to be used, uniformly charging both treated and untreated sets; a prescribed discharge procedure was to be used, uniformly discharging both treated and untreated sets. The manufacturer claimed that this test would show the following: (1) mechanical differences between the treated and untreated batteries at the conclusion of the test and (2) electrical differences between the treated and untreated batteries at the end of the test.

(1) Mechanical differences: (a) "Treated Batteries. The paste will be found soft and porous and the active material in both the positive and negative plates will be found to be in firm contact with the grids. There will be little peroxidation of the grids in the positive plates. There will be no warping or buckling of the plates and little shedding." (b) "Untreated batteries. It will be noted that the positive grids, if not entirely peroxided out in the positive plates and that the plates will disintegrate under pressure and twisting * * *. The active material in the negative plates will be found to be pried loose from the grid which will cause it to be chunky or sandy. (The plates may or may not be warped.) Shedding of the active material from the plates will be considerably heavier than in the treated batteries." Quotations from the manufacturer's test procedure.

(2) Electrical differences: (a) Treated Batteries. "The overall appearance of these batteries will indicate many months of useful service." (b) Untreated Batteries. "The condition of these batteries, if they were truly sulphated at the beginning, will show that they have little, if any, life expectancy, or they may be inert." Quotations from the manufacturer's test procedure. Translated into quantitative terms, the electrical differences would be revealed in a higher watt-hour capacity of the treated cells over the untreated cells.

3. Conduct of the test

Sulphated batteries were secured by the National Bureau of Standards. Only those approved by the manufacturer as acceptable for the test were used. The batteries were coded into groups of cells to be treated and groups of cells to remain untreated, serving as controls. The code was not known to the people carrying out the electrical tests.

The manufacturer supplied an ample quantity of his additive. His instructions were followed in introducing the additive to those cells which were to be treated.

The tests were conducted by members of the Bureau's staff and were witnessed by experts from other agencies of the Government and a representative of the manufacturer.

Comparisons of treated and untreated batteries were conducted by a group of Bureau scientists, a group of battery experts from other Government agencies, and representatives of the manufacturer (including the manufacturer himself). The detailed results of this aspect of the investigation are presented in Section III.

The data taken during the tests (temperature, specific gravity, voltage, amperage, time, etc.), relevant to effect of the additive on the batteries, are presented in Section IV. These data have been carefully analyzed by the Bureau's Statistical Engineering Laboratory. Statistical analysis of such is necessary if proper conclusions are to be drawn, for the batteries under test will inevitably show variations reflecting their varying backgrounds and life histories.

Chemical analysis of the additive was conducted by the Bureau's Chemistry Division. The results are presented in Section V.

4. Conclusions

The results of the above investigation, presented more fully in subsequent sections of this report, indicate that the battery additive tested has no beneficial effect on the properties or performances of batteries. These findings confirm previous studies of this additive (and similar additives) as reported in NBS Circular 504. It is worth noting that independent investigations, consisting of laboratory and field-service tests, conducted by two of the military services on this same additive yielded results in conformance with the Bureau's conclusions in Circular 504.

Chemical analysis (Section V) of the additive indicated that it is chiefly a mixture of magnesium sulfate, sodium sulfate, and a minor percentage of barium sulfate. This composition is essentially the same as that of a number of other additives examined during past years by the Bureau: in all cases, the results have shown that these materials are worthless.

The question is sometimes asked as to the meaning of many affidavits and testimonials certifying the value of an additive. The answer is twofold: (a) the claimant has not conducted a rigorous test and/or (b) the claimant has made an error in judgment. The critical element lacking in most tests is failure to maintain controls and failure to evaluate data by appropriate statistical techniques. For information on why batteries may appear not to be taking a charge in some cases, see NBS Circular 504, particularly page 27.

SECTION II: THE TEST

Details are given herein which relate to the following: (a) steps taken to determine the initial condition of 25 storage batteries procured from the Naval Aviation Supply Depot, Philadelphia, for use in testing the battery additive supplied by the manufacturer of the additive (hereinafter referred to as the manufacturer) and (b) the procedure followed in making electrical tests on the batteries after some of them had been treated with the additive.

1. Description of the batteries

The batteries were of the heavy duty type commonly used in buses. The batteries had been in storage in the wet condition for about 4 years and were received at NBS May 20, 1952. Each battery contained 6 cells assembled in a hard rubber tray. The cells were connected in series parallel to provide high capacity at 6 volts.

2. Initial condition of the batteries

All 25 batteries were delivered by NBS truck to a commercial battery shop on May 27 where the batteries were dismantled and inspected. One packing crate containing a single battery was opened at the NBS when the shipment was received. Six additional crates containing 4 batteries each were opened in the presence of the manufacturer upon their delivery to the battery shop.

A preliminary inspection of the batteries revealed raised positive terminals in 3 batteries. Raised terminals indicate expanded and unsound positive plates; therefore, these batteries were rejected. The remaining 22 batteries passed the preliminary inspection. Upon removing the elements from the batteries, the positive and negative plates were found to be sulfated and the negative plates were very hard. The positive plates in 6 batteries were expanded excessively and the grid frames of some of the plates in each element were cracked. These batteries were rejected. The plates in the 16 batteries which remained were in sound mechanical condition and the manufacturer approved these batteries for use in the test.

The separators in all elements were in good condition with the exception of two separators which were split, probably during inspection. The split separators were replaced with new ones and the elements were approved.

There was evidence of all batteries having been charged 3 times at different periods as indicated (1) by 3 small holes in the terminals where connectors had been attached and (2) by 3 distinct laminae of lead peroxide on the positive plate straps. The manufacturer of the additive claimed that the laminae on the plate straps indicated that the batteries had resisted charging and, in view of this and the hardened condition of the negative plates, he concluded that the batteries were in suitable condition (1) for the test and (2) to establish the merit of his additive. The proprietor of the commercial battery shop concurred in the manufacturer's conclusion.

The 16 batteries approved by the manufacturer were reassembled and the cells were connected to provide 2 six-volt batteries in each tray. This made a total of 32 six-volt batteries approved by the manufacturer for the test. During the inspection, the elements were placed over the cell compartments and allowed to drain so that no electrolyte was lost. No adjustment of the electrolyte levels was made at the battery shop. The batteries were sealed and returned to the NBS by the battery shop proprietor on May 29.

The manufacturer was granted permission to make experiments on 2 rejected batteries (12 cells) for his own information. The remaining rejected batteries were returned to NBS by the battery shop proprietory on June 2.

3. Positions and identification of the batteries for test

Each tray and the individual 6-volt batteries in the trays were numbered serially for identification. The trays were divided into 3 groups which were placed on separate test tables for charging on separate lines (see Sections III and IV). The batteries on each table were connected in series for charging from 110-volt d-c power with a rheostat in each circut for current control.

4. Outline and details of test procedure

The test consisted of the following steps: (1) Treating selected batteries according to code. (2) Charging all batteries. (3) Dismantling and inspecting the plates in selected batteries after charge. (4) Discharging batteries which were not dismantled.

Details of the test procedure, in general, followed the procedures established by the manufacturer of the additive, with certain modifications, as follows: (1) Both batteries in any tray on lines 1 and 2 will be either treated or left untreated. (2) The trays to be treated in lines 1 and 2 will be selected at random. (3) Individual batteries in line 3 will be selected and treated at random. (4) The charging procedure for batteries in line 3 may be altered at the discretion of the NBS. (5) No adjustment of the specific gravity will be made except in the event that the specific gravities of any 5 cells in lines 1 and 2, or any 6 cells in line 3 exceed 1.325, in which event the specific gravity will be reduced 10 points in all cells in the affected line. (This condition did not arise.) (6) If the temperature of any cell in a battery reaches 120° F., 49°C (± 1° C), the battery will be pulled from the charging line until it cools to 110° F., put back on charge (at prevailing rate) and continued until the battery has the total charge of the others. (This condition did not arise.) (7) The bend and twist test will not be used to determine the soundness of the positive plates. (8) The schedule for charging was formulated by the manufacturer to be as follows: (a) 5 amperes for 24 hours, (b) 14 amperes for 8 hours (day period), (c) 10 amperes for 16 hours (night period), (d) repeat (b) and (c) in order until charge is complete. (9) Termination of charge was modified as follows: terminate charge when more than ⅔ of the cells in any line show specific gravity increase in a 16-hour period of less than 10 points, however, all will be charged at least 4 days and none more than 5 days. (This condition was fulfilled in 4 days.) (10) Batteries selected for discharge will be discharged at 300 amperes to 3.0 volts, at 200 amperes to 3.0 volts and at 100 amperes to 1.0 volt or lower.

5. Addition of the battery additive

The manufacturer delivered 2 cartons (72 envelopes) of the battery additive and demonstrated how the material should be added. He specified that 1½ envelopes be added to each cell to be treated. The manufacturer's representative assisted in dividing the envelopes into the required number of halves after he and a member of the NBS staff had finished adjusting the level of the electrolyte by adding distilled water to the level guide plates as directed by the manufacturer. The manufacturer then inspected the charging circuits and testing equipment and left the laboratory. The charge was started at 11:00 A. M. and after adjusting the charging currents to 5 amperes, the laboratory personnel left the laboratory. The batteries to be treated were selected by a pattern established by the Bureau's Statistical Engineering Laboratory and the battery additive was added by another group. Following this, the laboratory personnel returned to the laboratory and continued the charge.

6. The charge

No readings were taken on the batteries prior to beginning the charge because differences between such readings and later readings might have indicated which batteries had been treated. The progress of the charge for each battery was indicated by recorded readings of specific gravities and voltages. To avoid the exchange of electrolyte between treated and untreated cells, each tray, lines 1 and 2, and each battery in line 3 was supplied with its own hydrometer and thermometer. About 2 hours were required to take and record a round of readings.

The levels of the electrolyte increased to the point of flooding in a number of cells during the first 21 hours of charging. Therefore, to prevent flooding as the charge proceeded, 50 millelites of electrolyte were removed from each cell. This electrolyte was stored in measuring cylinders marked with the battery identification numbers and returned to the respective cells after the levels had declined sufficiently. The time that the electrolyte was returned was noted on the data sheets. Water was added to all cells at a later period and again about 2 hours before terminating the charge in order to have the final levels the same as the initial levels. The amounts of water added in each instance are recorded on the data sheet together with the time.

Cadmium readings taken on all cells in line 3 after 46 hours (372 ampere-hours) of charging indicated that the charge had been practically completed. Following these cadmium readings, the batteries in line 3 were charged at the scheduled rate of 14 amperes for 8 hours. Then the charging rate was reduced and maintained at 10 amperes until the charge was terminated. The charge on lines 1 and 2 was terminated after a total uninterrupted charge of 4 days, 1 hour. By this time the batteries had received the charge provided by modification (9) of the test procedure. The charge on line 3 was terminated after continuous charging for 3 days and 23¼ hours.

7. Discharges

Five trays designated for dismantling for inspection of the plates were set aside after terminating the charge. The others were discharged in accordance with the test procedure to voltages shown in modification (10) of the procedure.

The batteries were discharged at 300, 200, and 100 amperes without interrupting the discharge while changing the rate. Voltage, temperature, and specific gravity readings were taken prior to discharge. Closed-circuit voltages were read at 30-second intervals and temperatures at less frequent intervals during the discharge. All readings were recorded together with the observed time.

The ampere-hour and watt-hour capacities of each battery to the specified cut-off voltage for each rate were computed and totalized. These values were tabulated and given to the NBS Statistical Engineering Laboratory.

8. Inspection of plates after charge

The elements were removed from trays set aside after the charge and inspected by a group of inspectors under the supervision of the Chief of the Statistical Engineering Laboratory. Each element inspected was identified by a code letter. The inspectors compared 2 elements at a time without knowing which had been treated.

SECTION III. OUTCOME OF INTERCOMPARISON BY VISUAL AND MANUAL INSPECTION

1. Conclusion

No statistically significant indication of any real difference was found between 5 batteries that were treated and 5 untreated controls.

2. Rankings of the batteries

The ranking, from lowest (1) to highest (10), of the individual batteries in terms of the total scores[1] they achieved on all 6 characteristics on the basis of the tallies of the 9 judges is as follows:

TABLE 1.—*Ranking of batteries on basis of overall scores*

Rank	1	2	3	4	5	6	7	8	9	10
Battery	U1	T8	U5	T4	T1	T11	U16	U10	U13	T12

Sum of ranks: Treated, 27; untreated, 28.

Since the sum of all ten ranks must equal 55 in any case, it is evident that the partition (27, 28), and its opposite (28, 27), are the most nearly equal divisions possible. In the present instance, the *untreated* received the larger of the two rank sums; but no importance can be attached to this event, since the *probability is exactly ½ of obtaining by chance a ranking as favorable or more favorable* to the untreated.

2.1 Rankings by the individual judges.—The rankings of the respective batteries in terms of the total scores received on the basis of the tallies of the individual judges is as shown in Table 2. In only three of the nine instances is the rank sum for the *treated* larger than the rank sum for the untreated; and the corresponding probabilities of obtaining by chance a ranking *equally or more favorable to the treated* are 0.5, 0.5, and 0.1, as indicated in the last column of the table. Clearly there is no significant evidence here in favor of the *treated*; nor in favor of the *untreated*.

[1] For details of the method of scoring, see 3.4 Tallies and scoring.

TABLE 2.—*Rankings of the batteries by individual judges*

Group and judge	Rank										Sum of ranks		P [1]
	1	2	3	4	5	6	7	8	9	10	Treated	Untreated	
I [2]													
A	T8	U1	U5	T1	T4	U16	U10	T11	U13	T12	28	27	0.5
B	U1 T8		U5 T4			T11 U10 U16 T1			U13	T12	28	27	.5
II [3]													
C	T8	T1	U16	T4		T11 U10 U13		U5	U1	T12	23	32	.8
D	T12		T11 U13 T1			U1 U5 T4		U10 T8		U16	21.5	33.5	.9
III [4]													
E	T4	U1	T12 U5		T11	T1	U16 T8		U13	U10	23	32	.8
F	T12		U1 T1 U5		U16 T8		T11	U13 T4		U10	25	30	.7
G	T12		U1 T8 U5		T4	T11 U13		T1	U10	U16	23.5	31.5	.8
IV [5]													
H	U5	T4	T12	U13 T1		T8	T11	U1 U10		U16	22.5	32.5	.9
I	U16	U10 T1		U1 U5		T11 T4		T12	U13	T8	33.5	21.5	.1

[1] P=probability of obtaining by chance a rank sum equal to or exceeding that observed for "treated."
[2] I. Representatives of the manufacturer.
[3] II. NBS battery experts.
[4] III. Battery experts from other Government agencies.
[5] IV. NBS scientists without previous battery-testing experience.

ference in spread (i. e., range) of the scores underlying the respective rankings shown in table 2 are considerable. Thus, on the basis of B's tallies, his "winner" (T12) received a total score of +45; and U1 and T8 tied for "worst" with scores of −25, making the total spread 70 units. A's scores ran similarly from +32 (for T12) to −24 (for T8), giving a spread of 56 units. On the other hand, D's scores ran from +4 (for U16) to −8 (for T12), a spread of only 12 units; and F's scores ran from +4 (for U10) to −6 (for T12), a spread of only 10 units. It may, therefore, be correctly argued that the top ranking for T12 given in table 1 is due in large part to the fact that A and B, who happened to favor T12 (which three other judges considered to be "worst"), by avoiding "−" tallies almost entirely, succeeded in achieving wide spreads to their scores; and their scores tend, therefore, to dominate the situation.

The influence (on the overall ranking of the batteries) of the difference in the spreads of the scores assigned by the individual judges can be effectively reduced by summing for each battery the ranks given in table 2—not the scores, as was done in preparing table 1—and then ranking these sums of ranks, to obtain the following variant of table 1:

TABLE 3.—*Ranking of batteries on basis of judges' rankings*

Rank	1	2	3	4	5	6	7	8	9	10
Battery	U5	U1 T1		T4	T8	T12	T11	U16	U13	U10

Sum of ranks: Treated, 24.5; untreated, 30.5.

A comparison of table 3 with table 1 reveals that T12 has taken quite a tumble and T8 has climbed a little—both treated batteries—and that the others are lined up in about the same order as before. The fine showing, in this representation, of untreated batteries U10, U16, and U13 is partially offset by the extremely poor showing of untreated batteries U1 and U5, with the result that the untreated all-in-all exhibit only a slightly greater edge over the treated than in table 1,

and the "edge" is not statistically significant—the probability is 0.3 of obtaining by chance a ranking as or more favorable to the untreated.

2.3 Rankings of the batteries on individual characteristics.—The rankings of the respective batteries on each of the 5 characteristics showing variation,[2] based on the total scores obtained on the respective characteristics from the tallies of all 9 judges, are given in table 4; and table 5 gives the corresponding rankings based on sums of the judges' rankings on the respective characteristics, to reduce the effect of score spreads on the final results. From a comparison of these two tables it is evident that the rankings are somewhat sensitive to the method of derivation. In no case, however, is the evidence significantly in favor of either the treated or the untreated.

3. The visual and manual inspection test, plan, and procedure

3.1 Preliminary details.—In accordance with agreements reached between the Bureau and the manufacturer of the additive, on the procedure to be followed in these electrical and inspection tests, a total of 32 shelf-sulfated lead-acid batteries were charged at the National Bureau of Standards. The batteries had been examined previously by representatives of the manufacturer of the additive and of the National Bureau of Standards, and were considered satisfactory for the test by both parties.

Prior to charging, 16 batteries chosen at random were treated with the additive, and the remaining 16 were left untreated as controls. The batteries were coupled together in pairs to form "trays" and were charged on three separate lines, the batteries on each being as follows:

Line 1: Battery—T3, T16—U2, U3—U8, U7—[T12, T11]—U1, U10.
Line 2: Battery—T14, T5—T7, T9—U15, U6—[U16, U13]—[T1, T8].
Line 3: Battery—T15, U14—T10, U12—[U5, T4]—T13, U11—U4, T6—U9, T2.

Thus line 1 contained 3 trays bearing untreated pairs and 2 bearing treated pairs; the converse was the case for line 2; and on line 3, the 6 trays were made up of dissimilar pairs. Apart from these restrictions on the arrangement, the assignment of individual batteries to the charging lines was done at random.

The random selection of the batteries that were to be treated, their treatment with the additive, and the arrangement of the batteries in the lines as shown above, were performed by individuals from outside of the Battery Laboratory, National Bureau of Standards, with no one else present. *Which of the batteries had been treated, and which had not, was not known to any one of the persons participating in, or present during the carrying out of, either the electrical or the inspection tests.*

Details are given in this Section only for the intercomparison of treated and untreated batteries by visual and manual inspection. The batteries employed in this intercomparison were those of the five pairs enclosed in brackets in the listing by charging lines given above. The statistical analysis of the results of the electrical tests is treated in Section IV.

TABLE 4.—*Rankings of the batteries on individual characteristics, on the basis of total scores*

Characteristics	Rank										Sum of ranks		P[1]
	1	2	3	4	5	6	7	8	9	10	Treated	Untreated	
Softness of positive plate	U1	T8 T4		U5	U16	T11	T1	U13	U10	T12	28	27	0.5
Softness of negative plate	U1 T4		T1	U5	T8	U10	U16	T11	U13	T12	27.5	27.5	.5
Adherence	U5	T8	U1 T1		T4	U16	T11	U13	U10	T12	27.5	27.5	.5
Peroxidation	T8	U1	U5	T11 T4		U13	T1	T12	U16	U10	25	30	.7
General condition	U1	U5	T8 T4		T12	T1	T11 U13		U16	U10	25.5	29.5	.7

[1] P=probability of obtaining by chance a rank sum equal to or exceeding that observed for "treated."

[2] In no instance was there any warping. Consequently all batteries were "—" in this respect, and this characteristic has been omitted from further consideration in the analysis.

TABLE 5.—*Rankings of the batteries on individual characteristics, on the basis of sums of judges' rankings*

Characteristics	Rank										Sum of ranks		P[1]
	1	2	3	4	5	6	7	8	9	10	Treated	Untreated	
Softness of positive plate	T4	U16 U5		U1	T11	T8	U13	T12	T1	U10	29	26	0.4
Softness of negative plate		U1 T1 T4		U5	U10	T8	U16	T11	U13	T12	28	27	.5
Adherence	U5	T1	T8	T11	T4	U16	U1	U13	T12	U10	23	32	.8
Peroxidation	T8	T11	U1	U5	T12 U13		T1	T4	U10	U16	23.5	31.5	.8
General condition	U1	U5	T12	T8	T4	T1	U13	U16	T11	U10	27	28	.6

[1] P = probability of obtaining by chance a rank sum equal to or exceeding that observed for "treated."

3.2 Date, place, and characteristics involved in the test.—The aforementioned 10 batteries were intercompared by visual and manual inspection with respect to the following 6 characteristics:

(a) softness of positive plate
(b) softness of negative plate
(c) adherence
(d) warping
(e) peroxidation
(f) general condition

The panel of judges.—A total of nine judges completed the full inspection program, as follows: Representatives of the manufacturer, 2; NBS battery experts, 2; battery experts from other Government agencies, 3; and NBS scientists without previous battery-test experience, 2.

3.3 Experiment design and procedure.—Each battery was compared with every one of the other 9 batteries by each of the 9 judges who completed the program—a total of 45 direct comparisons by each judge.

The batteries were presented for examination in 9 groups of 5 pairs each. These groups formed a *balanced incomplete block design* (see W. G. Cochran and Gertrude M. Cox, Experimental Designs [New York: John Wiley and Sons, Inc., 1950], Chapter 11, and especially Plan 11.14 on p. 331). The individual pairs were listed in order in the first column of the Tally Sheets that were given to the judges, with the battery numbers replaced by the letters A to J.

The comparisons called for in the first 5 groups were carried out in every case in terms of the *middle* cells of the *batteries* concerned—e. g., in the case of batteries T11 and T12 which were in the same tray, the 2nd and 5th cell counting from one end of the tray; and in the last four comparisons the cells corresponding to *central tray* positions—e. g. in the case of batteries T11 and T12, the 3rd and 4th from the end.

Prior to the first group of comparisons, the top (say, the "0th") negative plates of the (middle) cells of each of the 10 batteries were removed, and the battery pairs arranged in pans on 3 tables. Thus, in the 1st group, battery pairs U5, U1, and T11, U10 were on one table; pairs T4, U16, and T12, T8 on another; and T1, U13 on a third.

By visual and manual (e. g., tactual) examination, each judge in turn then compared the *top* (the 1st) *positive plate* of (the middle cell of) battery U5, say, with the *top positive plate* of (the middle cell of) battery U1; and the next negative plate (say the "1st") on battery U5 with the corresponding negative plate of battery U1; and so forth for the other comparisons in this first group. All 9 of these (middle) cells were then returned to the base point, where they were reorganized into the pairs called for in the second group of comparisons, e. g., U5 was now paired with T11, U1 with T12, and so forth.

Before representation for examination and comparison the positive and negative plates that had been examined were stripped from the cell units. Thus, the second group of comparisons was carried out in terms of the 2nd positive and "2nd" negative plates of the (middle) cells of the respective batteries. Similarly for the 3rd, 4th, and 5th groups of comparison, the 5th expending the bottommost positive and negative plates of these *middle* cells of the respective batteries. Consequently, the 6th group of comparisons was carried out in terms of the 1st positive and 1st negative plates of *tray-wise central* cells from each of the 10 batteries; and so forth, for the 7th, 8th, and 9th groups of comparisons.

Between each group of comparisons the cell units were carried back to the base point where they were readied for the next group of comparisons. None of the judges were permitted to visit the base point prior to, during, or immediately following the inspection test—so that no judge could note which cell units were from a single tray, and which were from different trays, or gain any other ancillary information that might possibly help him in his decisions.

3.4 Tallies and scoring.—For each comparison each judge indicated on his tally sheet by the appropriate letter which battery, if either, was in his opinion *superior* in regard to each of the six characteristics, respectively, recording and "=" in the case(s) of characteristics on which neither battery was superior to the other.

These symbolic tallies were subsequently converted to *scores* in the Statistical Engineering Labratory, National Bureau of Standards, by assigning in each instance a "+1" to the *battery favored* on a particular characteristic, and a "−1" to the other battery; or a "0" to each battery in the case of equality in respect to the characteristic concerned.

3.5 Statistical significance of results.—The principal results were given and their statistical significance appraised in section III, 2, *Rankings of the Batteries.* The technique employed there for judging statistical significance is due to Dr. Frank Wilcoxon, "Individual comparison by ranking methods," *Biometrics Bulletin*, vol. *1*, no. 6 (December 1945), pp. 80–83: and has been considered somewhat more fully by H. B. Mann and D. R. Whitney, "On a test of whether one of two random variables is stochastically larger than the other." *Annals of Mathematical Statistics*, vol. *18*, no. 1 (March 1947), pp. 50–60. The probabilities given in connection with tables 1–5 were taken directly from Table I of Mann and Whitney in the case of integer rank sums, and in the case of fractional rank sums were calculated by linear interpolation between the adjacent interger values.

SECTION IV: STATISTICAL ANALYSIS OF TEMPERATURE, SPECIFIC GRAVITY, AND WATT-HOUR DATA

1. Introduction

The results given below relate to 20 shelf-sulfated lead-acid batteries that were charged and discharged at the National Bureau of Standards in accordance with agreements reached between the Bureau and the manufacturer of the additive. Prior to charging, 10 of these batteries, chosen at random, were *treated* with the additive, and the remaining 10 were left *untreated.*

These batteries were coupled together in pairs to form "trays" and were charged on two lines as follows:

	Treated		Untreated	
	Tray	Batteries	Tray	Batteries
Line 1	1	T3, T16	2	U2, U3.
	4	T12, T11	3	U8, U7.
			5	U1, U10.
Line 2	6	T14, T5	8	U15, U6.
	7	T7, T9	9	U16, U13.
	10	T1, T8		

See section III, 3.1 for details on the random assignment of the batteries to the treated and untreated groups.

Temperature and specific gravity measurements were made on each of the 6 cells of a tray at the end of each of 9 charging periods. For details of the charging schedule and measurement procedures, see section II.

2. Conclusions

2.1 Temperature during charging.—No statistically significant indication of any real difference with respect to temperature during charging was found between the 5 trays of batteries treated with the additive and the 5 trays of batteries used as untreated controls. (See sec. IV, 3.)

2.2 Specific gravity.—The shapes of the specific gravity-charging period curve for the treated and untreated sets of batteries are essentially the same except for constant difference of approximately 0.0035. (See sec. IV, 4.)

2.3 Watt-hours.—No statistically significant indication was found of any real difference between the 3 trays of batteries treated with the additive and the 3

trays of batteries used as untreated controls with respect to watt-hours delivered upon discharge. (See sec. IV, 5.)

2.4 Supplementary study of watt-hours (in addition to agreed-upon tests).—The supplementary study of paired comparisons of treated and untreated batteries using trays in which one battery was treated and the other was left untreated yielded a slight, but not statistically significant, increase in watt-hours delivered in discharge in favor of the untreated batteries. (See sec. IV, 6.)

3. Comparison of temperatures during charging

The individual tray values (average of 6 cell temperatures) for the 10 trays are given in table I and plotted in figure 1 for each of the 9 charging periods. The average temperatures for the 5 treated trays and for the 5 untreated trays are plotted against charging period in figure 2.

In 4 of the 9 time periods the average temperature for the treated trays is less than that of the corresponding untreated trays; in the remaining 5 time periods the untreated trays had an equal or lower average temperature.

The largest differences occurred in the seventh charging period, where a difference between the averages (treated minus untreated) of —.80° was observed. The range of values for the treated trays was 3.15° and for the untreated trays, 1.30°. In the light of variability of this order of magnitude within the two sets of measurements, an interval estimate of the true difference (having probability 0.95 of including the "true" value of the difference) turns out to be (—2.1, 0.5). Thus the observed difference is statistically consistent with any true difference value between —2.1 and +0.5, including zero (i. e., no difference); and the largest difference with which it is consistent (i. e., —2.1) would hardly be of any practical importance.

In order to test the statistical significance of the difference between treated and untreated trays with respect to temperature for each of 9 time periods, the trays were ranked according to temperature (highest temperature having rank 1; the lowest, rank 10). The rank and the rank totals for the treated and untreated trays are shown in table II. In the last line of table II is given the probability of obtaining by chance a rank total equal to or exceeding that observed for treated None of the differences in rank totals for the individual charging periods can be regarded as statistically significant.

4. Comparison of specific-gravity values during charging

The individual tray values (average of 6 cell measurements) for specific gravity for each of the 9 charging periods are given in table III. The curves of specific gravity versus charging period are shown in figure 3.

TABLE I.—*Average temperature (°C) of trays for each charging period*

	Tray	Batteries	Charging period								
			1	2	3	4	5	6	7	8	9
Treated	1	T3, T16	28.20	31.80	38.10	45.90	37.45	44.20	46.15	46.65	45.10
	4	T12, T11	27.95	31.75	39.55	46.65	39.00	45.15	47.80	47.15	44.05
	6	T14, T5	28.35	32.35	40.10	44.20	39.15	43.40	46.25	47.60	45.70
	7	T7, T9	28.85	32.45	40.80	45.50	40.00	43.45	46.10	47.50	45.80
	10	T1, T8	28.30	32.60	41.40	43.70	37.65	42.35	44.65	46.55	43.95
Average			28.33	32.19	39.99	45.19	38.65	43.71	46.19	47.09	44.92
Untreated	2	U2, U3	28.30	31.70	38.30	45.75	39.10	44.45	46.60	46.15	44.05
	3	U8, U7	28.70	32.25	39.25	46.75	40.60	45.40	47.25	45.70	42.95
	5	U1, U10	28.50	32.70	40.95	45.45	38.80	45.05	47.75	46.40	45.50
	8	U15, U6	27.95	32.05	40.45	45.65	38.95	43.40	46.45	48.40	44.15
	9	U16, U13	28.20	32.05	40.85	45.30	39.40	44.10	46.90	47.95	44.35
Average			28.33	32.15	39.96	45.78	39.37	44.48	46.99	46.92	44.20
Differences in averages, treated minus untreated.			0	.04	.03	—.59	—.72	—.77	—.80	.17	.72

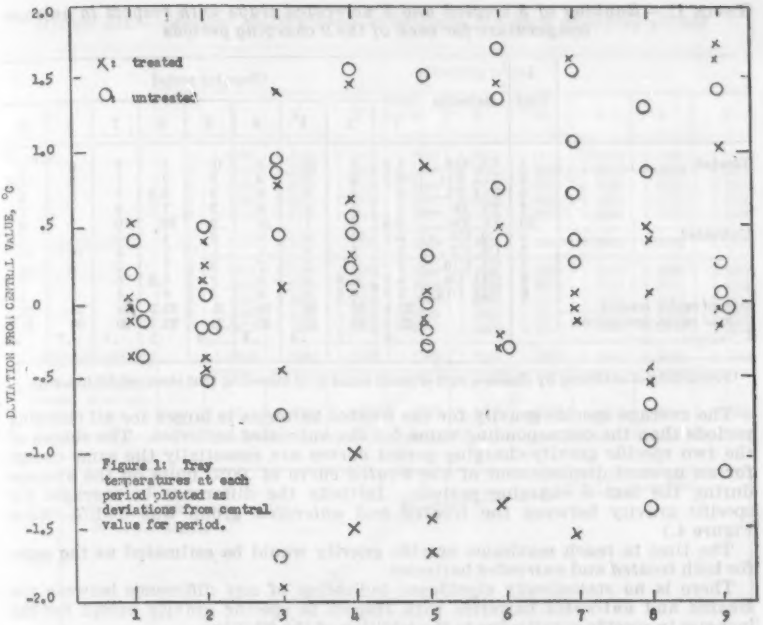

Figure 1: Tray temperatures at each period plotted as deviations from central value for period.

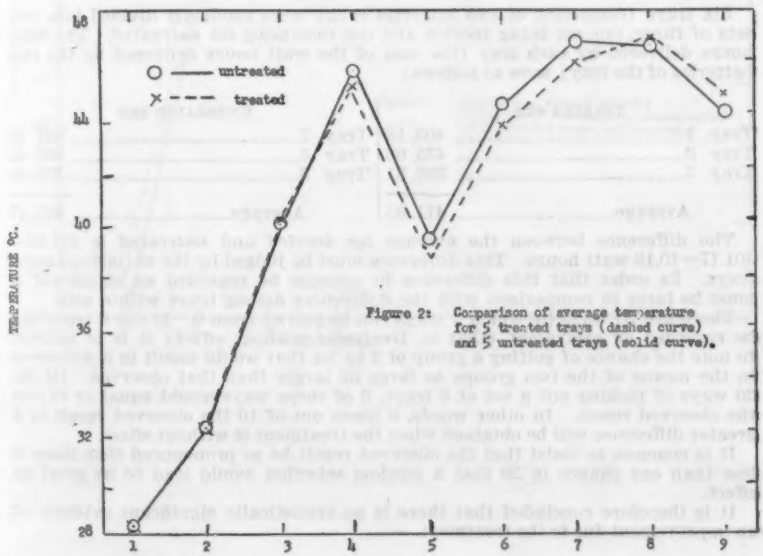

Figure 2: Comparison of average temperature for 5 treated trays (dashed curve) and 5 untreated trays (solid curve).

TABLE II.—*Ranking of 5 treated and 5 untreated trays with respect to average temperature for each of the 9 charging periods*

	Tray	Batteries	Charging period								
			1	2	3	4	5	6	7	8	9
Treated	1	T3, T16	7.5	8	10	3	10	5	8	6	4
	4	T12, T11	9.5	9	7	2	6	2	1	5	7.5
	6	T14, T5	4	4	6	9	4	8.5	7	3	2
	7	T7, T9	1	3	4	6	2	7	9	4	1
	10	T1, T8	5.5	2	1	10	9	10	10	7	9
Untreated	2	U2, U3	5.5	10	9	4	5	4	5	9	7.5
	3	U8, U7	2	5	8	1	1	1	3	10	10
	5	U1, U10	3	1	2	7	8	3	2	8	3
	8	U15, U6	9.5	6.5	5	5	7	8.5	6	1	6
	9	U16, U13	7.5	6.5	3	8	3	6	4	2	5
Sum of ranks, treated			27.5	26	28	30	31	32.5	35	25	23.5
Sum of ranks, untreated			27.5	29	27	25	24	22.5	20	30	31.5
P [1]			.5	.7	.5	.3	.3	.2	.1	.7	.8

[1] Probability of obtaining by chance a sum of ranks equal to or exceeding that observed for treated.

The average specific gravity for the *treated* batteries is larger for all charging periods than the corresponding value for the *untreated* batteries. The shapes of the two specific gravity-charging period curves are essentially the same except for an upward displacement of the *treated* curve of .0035 units on the average during the last 8 charging periods. Initially the difference in averages for specific gravity between the *treated* and *untreated* group was 0.0197. (See Figure 4.)

The time to reach maximum specific gravity would be estimated as the same for both *treated* and *untreated* batteries.

There is no statistically significant indication of any difference between the *treated* and *untreated* batteries with respect to specific gravity except for the increase in specific gravity due to the addition of the additive.

5 Comparison of watt hour values in discharging

Six trays (consisting of two batteries each) were randomly divided into two sets of three, one set being *treated* and the remaining set *untreated*. The watt hours delivered by each tray (the sum of the watt hours delivered by the two batteries of the tray) were as follows:

TREATED SET		UNTREATED SET	
Tray 1	403.18	Tray 2	421.44
Tray 6	435.06	Tray 3	402.42
Tray 7	395.81	Tray 8	379.64
Average	411.35	Average	401.17

The difference between the average for *treated* and *untreated* is 411.35–401.17=10.18 watt hours. This difference must be judged by the variation among trays. In order that this difference in average be regarded as significant it must be large in comparison with the differences among trays within sets.

There are 20 ways by which 3 trays can be picked from 6. If the 6 trays can be regarded as equivalent (that is, treatment without effect) it is of interest to note the chance of getting a group of 3 by lot that would result in a difference in the means of the two groups as large or larger than that observed. Of the 20 ways of picking out a set of 3 trays, 6 of these ways would equal or exceed the observed result. In other words, 3 times out of 10 the observed result or a greater difference will be obtained when the treatment is without effect.

It is common to insist that the observed result be so pronounced that there is less than one chance in 20 that a random selection would lead to as great an effect.

It is therefore concluded that there is no statistically significant evidence of an improvement due to the treatment.

TABLE III.—*Average specific gravity of trays for each charging period*

	Tray	Charging period								
		1	2	3	4	5	6	7	8	9
Treated	1	1.1400	1.2385	1.2575	1.2810	1.3075	1.3115	1.3120	1.3100	1.3150
	4	1.0940	1.2240	1.2340	1.2600	1.2895	1.2885	1.2910	1.2965	1.2970
	6	1.0900	1.2185	1.2330	1.2555	1.2870	1.2875	1.2890	1.2970	1.3015
	7	1.1180	1.2325	1.2465	1.2645	1.3015	1.3065	1.3075	1.3170	1.3160
	10	1.1115	1.2250	1.2395	1.2660	1.2965	1.2975	1.3020	1.3075	1.3100
Average (treated)	------	1.1107	1.2273	1.2421	1.2654	1.2964	1.2983	1.3003	1.3056	1.3079
Untreated	2	1.0855	1.2240	1.2265	1.2585	1.2965	1.3000	1.3000	1.3000	1.3050
	3	1.0885	1.2260	1.2390	1.2580	1.2930	1.2970	1.3015	1.3085	1.3150
	5	1.1135	1.2320	1.2460	1.2660	1.2965	1.3015	1.3050	1.3065	1.3105
	8	1.0840	1.2155	1.2300	1.2525	1.2865	1.2965	1.2885	1.2970	1.2975
	9	1.0835	1.2200	1.2435	1.2645	1.2930	1.2935	1.2985	1.2900	1.2975
Average (untreated)	------	1.0910	1.2235	1.2370	1.2599	1.2931	1.2977	1.2987	1.3004	1.3051
Difference between treated and untreated	------	.0197	.0038	.0051	.0055	.0033	.0006	.0016	.0052	.0028

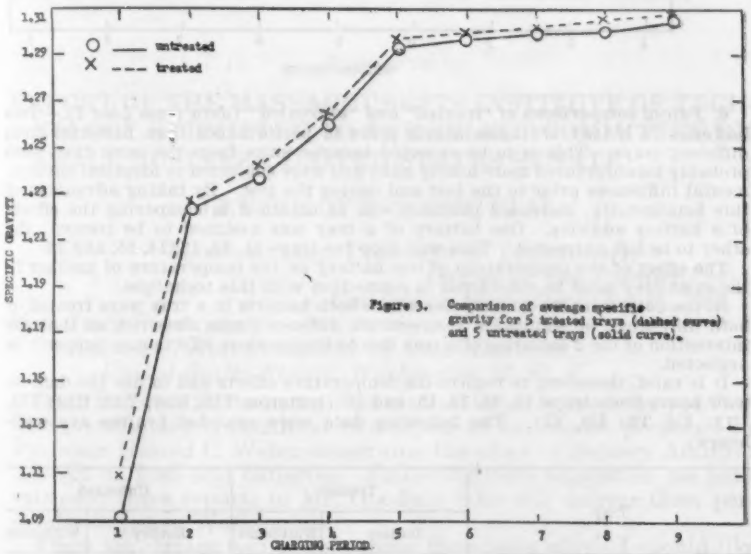

Figure 3. Comparison of average specific gravity for 5 treated trays (dashed curve) and 5 untreated trays (solid curve).

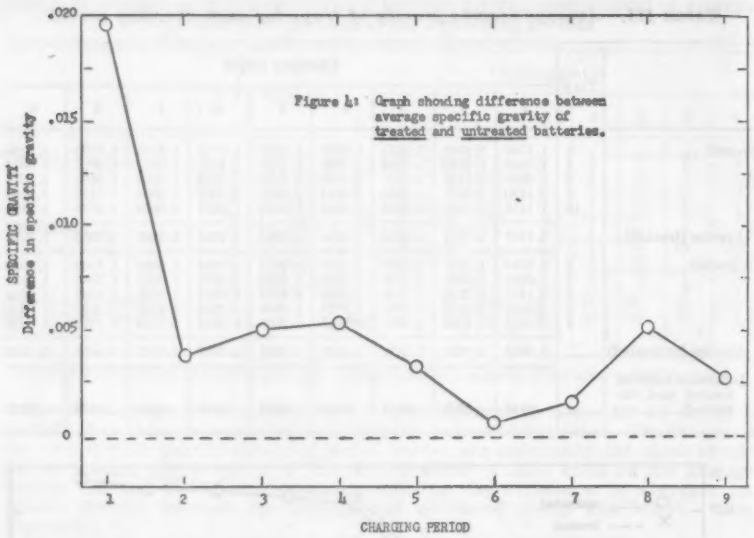

Figure 4: Graph showing difference between average specific gravity of treated and untreated batteries.

6. Paired comparisons of "treated" and "untreated" (data from Line 3).—Two batteries in a tray are more nearly alike in performance than batteries from different trays. This is to be expected because units from the same tray were probably manufactured more nearly alike and were subjected to identical environmental influences prior to the test and during the test. By taking advantage of this homogeneity, increased precision can be obtained in comparing the effects of a battery additive. One battery of a tray was assigned to be treated; the other to be left untreated. This was done for trays 11, 12, 13, 14, 15, and 16.

The effect of the temperature of one battery on the temperature of another in the same tray must be considered in connection with this technique.

In the data from the 20 batteries where both batteris in a tray were treated or both untreated, no significant temperature difference was observed, so that the interaction of the 2 batteries of a tray due to temperature effects may properly be neglected.

It is valid, therefore, to neglect the temperature effects and to use the data on watt-hours from trays 11, 12, 14, 15, and 16 (batteries T15, U14; T10, U12; T13, U11; U4, T6; U9, T2). The following data were recorded (values are watt-hours).

Tray	Treated		Untreated	
	Battery	Watt-hours	Battery	Watt-hours
11	T15	207.06	U14	213.07
12	T10	228.63	U12	230.10
14	T13	238.18	U11	238.95
15	T6	213.68	U4	211.94
16	T2	169.91	U9	167.62
Average		211.492		212.336

The untreated batteries averaged (212.336—211.492)=.844 watt hours more than the treated batteries. The differences between untreated and treated (6.01, 1.47, .77, —1.74, —2.29) are not consistent enough for this slight difference in average watt hours to be regarded as significant from a statistical point of view.

The effectiveness of this technique of comparison is illustrated by the fact that although tray 16 yields extremely low watt-hour values relative to the other trays, the comparison of treated and untreated batteries is not upset by this departure, since both the treated and untreated batteries simultaneously reflect this departure. (Tray 16 was not abnormal with regard to temperature or specific gravity.) The precision of comparisons would be severely reduced if this variability among trays had not been balanced out.

SECTION V. CHEMICAL ANALYSIS

	Percent
1. Solubility:	
Soluble in water	99.84
Insoluble in water	0.16
2. Composition of water-soluble fraction:	
Magnesium sulfate, anhydrous ($MgSO_4$, calculated from total MgO)	47.3
Sodium sulfate, anhydrous (Na_2SO_4, calculated from excess SO_4)	41.2
Water of hydration	11.5
3. Composition of water-insoluble fraction: Mainly barium sulfate, $BaSO_4$.	

EXHIBIT 10

REPORT OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY SUBMITTED TO THE SELECT COMMITTEE ON SMALL BUSINESS, UNITED STATES SENATE

LETTER OF TRANSMITTAL

MASSACHUSETTS INSTITUTE OF TECHNOLOGY,
OFFICE OF THE PROVOST,
Cambridge, Mass., December 16, 1952.

Hon. JOHN SPARKMAN,
Chairman, Select Committee on Small Business,
United States Senate, Washington 25, D. C.

DEAR SENATOR SPARKMAN: This airmail letter is to advise you that we have this day transmitted two copies of the report prepared by Professor Harold C. Weber concerning the effect of Battery Additive AD–X2 on lead acid batteries. Following your suggestion we have entrusted these reports to Mr. Goodwin who will deliver them personally to you in Washington.

There are certain points concerning these tests which I should like to emphasize.

We are making the results of the tests available solely to the Select Committee on Small Business. M. I. T. will make no public statement in connection with this investigation.

As you know, this work was undertaken by M. I. T. upon the request of your committee and, while we were reluctant to become involved in a controversial issue, we felt that we should make our

facilities available to you in the public interest. All expenses in connection with these tests were covered by M. I. T. The M. I. T. staff members who worked on the tests received no compensation from any source, and they have no financial or consulting interest in the product tested or in other similar products.

I would point out further that there are no recommendations included in the report, nor did our group arrive at any definitive conclusions with respect to the commercial value of the product. The report sets forth the results of very careful laboratory tests, and these results have been corroborated and analyzed statistically.

Four copies of the report have been prepared, two of which are being sent to you and the other two will remain here at M. I. T.

Professor Weber has gone to great pains and a considerable personal sacrifice in time to conduct a thorough, competent, and completely nonpartisan investigation of the effects of product AD–X2 on lead acid battery cells. We hope that the report will contribute to the important work of your committee.

Very sincerely yours,

J. A. Stratton,
Vice President and Provost.

SOME FACTS CONCERNING THE EFFECT OF BATTERY ADDITIVE AD–X2 ON LEAD ACID BATTERIES

1. Authority

The work covered by this report was undertaken at the request of the Select Committee on Small Business of the United States Senate, to render a public service through this Committee.

In a desire to employ its facilities as fully as possible in the public interest, and at the request of the Select Committee on Small Business of the United States Senate, the Massachusetts Institute of Technology made available laboratory services and facilities for carrying out tests.

2. Scope of Investigation

This investigation concerns some of the effects noted when Battery Additive AD–X2 was added to lead acid storage batteries. The finding of facts was considered of more importance at this time than the development of any theory to explain the facts. Theoretical discussion will be pursued only as far as is deemed necessary for the proper presentation of the facts reported. This viewpoint is not to be interpreted as indicating that a theory for the action of this and possibly other similar battery additives has not been developed.

A complete investigation would have required extensive laboratory and field experimentation. Because of the limited time available, a laboratory procedure based on tests which could be performed rapidly was developed. This test method did show several differences between cells treated with AD–X2 as compared with untreated cells.

3. Supporting Scientific Authority

In view of the widespread feeling that battery additives—particularly those composed largely of mixtures of magnesium and sodium sulphate—have no beneficial action on batteries, it was thought

advisable to obtain supporting scientific confirmation for the facts found. Through the office of the President of the Massachusetts Institute of Technology, Prof. James A. Beattie of the Chemistry Department was asked to observe the experiments and to verify independently the facts established. Prof. Beattie observed a portion of the experimental work, and, in the limited amount of time he had available, did verify most of the facts tabulated in the next section.

Through the same authority, Prof. G. P. Wadsworth and Dr. J. G. Bryan were requested to analyze the results statistically.

4. Recommendations

None, since the purpose of this work was to establish facts.

Definitions

In this report, the word "cell" will be used to designate a single unit consisting of a set of positive and negative plates, together with the container in which they are held. The word "battery" will be used to designate any group of cells which has been subjected to the same treatment. Cells in any one battery should be comparable, one with the other. Comparisons between batteries are undesirable; rather comparisons should be limited to the different cells in any particular battery.

5. Summary of Results

For the cells tested:

(*a*) Among the cells in any chosen battery, all cells in such battery having been subjected to the same previous history, except for treatment with AD–X2, treated cells showed larger capacities than did untreated cells, both being subjected to the same conditions of discharge.

(*b*) When AD–X2 was added to cells containing sediment, the amount of sediment decreased both while the battery was on charge and when it was not on charge.

(*c*) Cells treated with AD–X2 when on charge presented a markedly different appearance from those on charge without treatment. The gas evolved in the treated cells was in the form of minute bubbles, while that evolved in the untreated cells was in bubbles estimated to be 4 to 10 times as large as those evolved in the treated. The liquid surface in the treated cells presented a different appearance from that in the untreated cells.

(*d*) The surface of a negative plate in a treated cell was distinctly softer than the surface of a similar plate in an untreated cell, both having been subjected to the same charge conditions. Often, softening was first evident near the edges of the negative plate.

(*e*) Under similar charge conditions, treated cells lost less liquid than untreated cells.

(*f*) Under identical conditions of charge, treated cells operated 2 to 5 degrees Fahrenheit cooler than did untreated cells.

(*g*) During charge, and starting with discharged cells, treated cells gave higher hydrometric readings than did untreated cells, the differences being greater than could be explained on the basis of the treating material added.

(*h*) When AD–X2 was added to a cell containing a diluted electrolyte, as in a discharged cell, the conductivity of the electrolyte increased.

6. Discussion of Results

In this section, each of the eight facts presented under "Summary of Results" will be supported by the laboratory data collected during the tests performed. All of the data in this section have been taken from the more complete data presented in the Appendix. Comments to aid in understanding and interpreting these supporting data, here presented, will be added when it is believed these will be helpful.

(*a*) Among the cells in any chosen battery, all cells in such battery having been subjected to the same previous history, except for treatment with AD–X2, treated cells showed larger capacities than did untreated cells, both being subjected to the same conditions of discharge.

Laboratory data in support of this fact are given in Table I.

For clarity, certain expressions used in this tabulation are defined at this point.

Preliminary selection test means that the cell was charged for a short period at a low rate, and then discharged at a low rate, in an attempt to learn something of the condition of this cell relative to the others in the same battery before any cells were treated.

First discharge means that the cell, following the preliminary selection test, was given a short charge, either with or without AD–X2 added, as indicated in the table, and then subjected to a rather heavy discharge.

First recovery means that the cell was subjected to an additional discharge after having undergone a discharge and after having been allowed a rest period, but without having received any additional charge.

Second recovery means that the cell was subjected, after a second rest period, to a second discharge without having received any additional charge.

Second discharge means that the cell, irrespective of its previous treatment, had received a second charge and had then been subjected to a second discharge.

Third discharge means that the cell, irrespective of its previous treatment, had received a third charge and had then been subjected to a third discharge.

In the following tabulation, numbers following the phrases defined on the preceding page refer to the minutes duration of the test being tabulated. Cells marked with an asterisk have been treated with AD–X2. It is to be remembered that, in evaluating the various cells, only cells in the same battery are to be specifically compared. Variation from battery to battery, irrespective of the test treatment received, is believed too great to warrant interbattery comparison.

Table I

Cell No.	1	2*	3
First Discharge	36½	33	26
First Recovery	22	26½	19
Second Discharge	44½	46½	38½

Reference to the Appendix will show that Cells 1 and 3 have an unfair advantage, since on the first attempt to charge these three cells, Cell 2 developed an internal short circuit which was found after 9 hours and 10 minutes of charging, during which time sulphate was being eliminated in Cells 1 and 3, but not in Cell 2.

Moreover, during Second Discharge the connecting lug broke on Cell 2 making necessary a makeshift connection which could have shortened the time of Second Discharge for Cell 2. In spite of these two adverse effects, Cell 2 still tests better than Cells 1 or 3.

Cell No.	4	5*
First Discharge	6 min.	55 min.
First Recovery	0	24 min.
Second Recovery	0	14 min.
Second Discharge	5½ min.	80¾ min.
	AD–X2 now added to Cell 4 and charged for 58 min. at 7 amp.	
Third Discharge	8¼ min.	

When Cell 4 was discharged after 58 min. at 7 amp. without AD–X2, it could be discharged at 5 amp. for 5½ min. When AD–X2 was added and same cell charged for 58 min. at 7 amps., it could be discharged at 5 amp. for 8¼ minutes, even though 58 minutes is too short a charge time to get the full effect of AD–X2, according to the manufacturer. There are two effects to be noted: (1) After treatment, Cell 4 is recovering at a faster rate than it was before treatment. (2) Even though Cell 4 made a very poor showing against treated Cell 5, it seems probable that eventually Cell 4 will become as good as Cell 5, indicating that Cell 4 is suffering from chemical, rather than mechanical deterioration.

Cell No.	6	7*
First Discharge	8 min.	15 min.
Second Discharge	20 min.	30 min.
First Recovery	2 min.	12 min.
Second Recovery	DEAD	7 min.
Third Discharge	4⅛ min.	55¼ min.

Cell No.	8	9	10*
	Battery was discharged and allowed to stand.		
First Recovery	DEAD	17¾ min.	17¾ min.

This was a new unused low-priced automobile battery. Treated cell shows no advantage over untreated, as would be expected in a new battery. Even though new, one cell of this battery, Cell 8, had a partial internal short, as indicated by its going dead on standing.

It is unusual to find two cells, even in the same battery, as close in test characteristics as are Cells 9 and 10.

Cell No.	11*	12*	13	14
	By selection test, Cell 11 was worst cell; Cells 12-13-14 about equal condition. and then cells discharged to 1 amp. on short circuit.			Battery charged
First Recovery	21 min. 15 sec.	27 min. 45 sec.	20 min. 30 sec.	19 min. 45 sec.
Second Recovery	24 min.	26 min. 45 sec.	17 min. 48 sec.	23 min. 48 sec.

Cell No.	15*	16
	By selection test, Cell 15 was poorer.	
First Discharge	9 min. 30 sec.	10 min. 20 sec.
Second Discharge	11 min.	10 min. 30 sec.
Third Discharge	47 min.	45 min. 50 sec.
Fourth Discharge	21 min.	24 min. 10 sec.

Cell No.	17	18	19	20*	21	22*
	Treated cells were worst two cells in battery by selection test.					
First Discharge	18 min. 45 sec.	Terminal broke	37 min. 30 sec.	23 min. 45 sec.	29 min. 30 sec.	33 min.

Cell No.	23	24*	25	26*	27	28*
	All cells in this battery were dead by selection test, except Cell No. 23.					
First Discharge	25 min. 30 sec.	21 min. 15 sec.	16 min.	19 min. 15 sec.	14 min. 20 sec.	26 min. 30 sec.

Note that one treated cell is slightly better than the best cell in the battery, Cell 23 untreated, and of the other four, the two treated cells are better than the two untreated cells.

Cell No.	29	30*
	No preliminary selection test made.	
First Discharge	46 min. 30 sec.	75 min. 15 sec.

Cell No.	31*	32*	33	34
	No preliminary selection test made.			
First Discharge	14 min. 50 sec.	13 min. 45 sec.	6 min. 35 sec.	6 min. 1 sec.
Second Discharge	24 min. 15 sec.	22 min. 45 sec.	22 min. 10 sec.	18 min. 40 sec.
First Recovery	77 min. 30 sec.	Not Done	78 min. 30 sec.	Not Done

This battery was made from two large cells. The four resulting cells are of low ampere-hour capacity. These figures could indicate that because of this, the untreated cells after two periods of charging have recovered sufficiently to equal the treated cells, a result which would not be unexpected under such conditions.

Cell No.	35	36*	37	38*	39	40

All cells showed dead on preliminary selection test except Cell 37. Cells 35 and 36 found to be shorted through case. Case resistance between 36 and 37 less than 2000 ohms. Discard 35–36–37, since with 35 and 36 useless there are no cells for direct comparison with 37. Also discarded Cells 38, 39, 40, since these showed dead after treating and trying to charge. Evidently, case is shorted from cell to cell. All succeeding cells of this type will be transferred to hard rubber cases with empty pockets between cells.

Cell No.	41	42*

By selection test, both cells were dead. Cell 42 treated. Although two attempts were made to charge these cells, neither would take a charge. On second attempt, Cell 41 sulphated out and both cells were discarded.

Cell No.	43	44*
	By selection test, both cells were dead. Cell 44 treated.	
First Discharge	4 min.	12 min. 30 sec.

Cell No.	45*	46
	By selection test, both cells were dead. Cell 45 treated.	
First Discharge	DEAD	DEAD
Second Discharge	19 min. 45 sec.	9 min.

Cell No.	47*	48
	Both cells dead by selection test. Cell 47 treated.	
First Discharge	Less than 1 min.	DEAD
Second Discharge	13 min.	DEAD
Third Discharge	28 min.	5 min.

After Second Discharge, Cell 48 might have been judged mechanically defective. However, after third discharge, it must be concluded that the difficulty is chemical deterioration which is being corrected as recharging continues. Because

of treatment, chemical deterioration in Cell 47 is evidently being corrected more rapidly than in untreated Cell 48.

Cell No.	49	50*
	Both cells dead, by selection test. Cell 50 treated.	
First Discharge	DEAD	DEAD
Second Discharge	7 min. 10 sec.	11 min. 45 sec.

Cell No.	51	52*
	Both cells dead by selection test. Treated Cell 52.	
First Discharge	11 min. 30 sec.	8 min. 45 sec.
Second Discharge	7 min. 15 sec.	5 min. 15 sec.

On examining cells, Cells 51 and 52, Cell 52 had four cracked positives, but 51 had none. This fact should be considered in comparing these two cells.

Cell No.	53*	54
	Both cells dead by selection test. Cell 53 treated.	
First Discharge	30 min. 30 sec.	30 sec.
Second Discharge	19 min. 50 sec.	1 min. 40 sec.
Third Discharge	4 min. 55 sec.	30 sec.
Fourth Discharge	40 min.	8 min. 25 sec.

Note that Cell 54 is evidently not mechanically defective since on repeated charge and discharge, it is recovering slowly, as would be expected. Assuming both cells originally of equal condition, note rapid recovery of Cell 53.

Cell No.	55*	56
	Both cells dead by selection test. Cell 55 treated.	
First Discharge	2 min. 5 sec.	1 min.
Second Discharge	10 sec.	20 sec.
Third Discharge	16 min. 10 sec.[1]	12 min. 15 sec.

[1] Bad connection on voltmeter on Cell 55. This Cell would have run longer.

(*b*) When AD–X2 was added to cells containing sediment, the amount of sediment decreased both while the battery was on charge and while it was not on charge.

A small glass-cased Willard thick plate cell, approximately 15 years old, had been left in an uncharged condition for several years. Well over an inch of sediment had collected in the bottom of the cell, and the liquid level had fallen over two inches below the tops of the plates. Distilled water was added to restore the level, Battery AD–X2 was added to the cell, and the unit placed on charge at 3 amperes. In several hours sediment reduction was evident, and by the time the cell was fully charged, the sediment was less than ¼ inch deep in the cell bottom. This occurred in May 1952. During the present series of tests this cell was again examined, and it was evident to those present and also present when the cell was originally charged after treatment that sediment has shown a further considerable decrease. The cell has not been recharged.

Two groups of two cells, each of heavy plate Exide batteries (two plates per cell) were observed in the summer of 1952 at the Army Base in Boston. It was said that before treatment with AD–X2

these cells contained so much sediment that it was above the bottom of the plates, and some cells were being partially shorted by the sediment. The cells were treated about January 1952. When observed in July, the sediment had receded about ½ inch below the bottoms of the plates. The cells were moved to Cambridge in September where they could be more readily observed. Sediment in one pair of cells is now approximately 1⅛ inches below the plate bottoms, while in the other pair it is about 1 inch below the plates. On November 6 at 1:30 p. m. the second pair was placed on charge at 4 amp. until 5 p. m. On succeeding days for one week this pair was alternately charged and discharged. From marks placed on the glass cases, a reduction of about ⅛ inch in sediment depth has been noted, some of this occurring while the cells were sitting idle for several days after the charge-discharge cycle. Complete sediment disappearance is not expected in these cells, but the level has receded to a point where difficulty from sediment is a remote possibility.

A record is made at this time of an automobile battery in a rubber case. A hole was accidentally knocked in the side of the case by a stone thrown up from the road. Although the battery was eighteen months old and had been treated with AD–X2 six months previously, no sediment was found in the cell bottom, although some would have been expected. Incidentally, the negative plate exposed through the hole was soft and apparently in excellent condition.

(*c*) Cells treated with AD–X2 when on charge presented a markedly different appearance from those on charge without treatment. The gas evolved in the treated cells was in the form of minute bubbles, while that evolved in the untreated cells was in bubbles estimated to be 4 to 10 times as large as those evolved in the untreated. The liquid surface in the treated cells presented a different appearance from that in the untreated cells.

Differences of the type above described were noted in batteries made up of Cells 31–32–33–34, 49–50, 45–46, 53–54, 44–43, and are specifically mentioned in the Appendix.

(*d*) The surface of a negative plate in a treated cell was distinctly softer than the surface of a similar plate in an untreated cell, both having been subjected to the same charge conditions. Often softening was first evident near the edges of the negative plate.

This difference was noted in batteries made up of Cells 4–5, 6–7, 51–52, 53–54, and is specifically mentioned in the Appendix.

(*e*) Under similar charge conditions, treated cells lost less liquid than untreated cells.

This fact is substantiated by Table II. Treated cells are indicated by an asterisk.

Table II

Cell No.	31*	32*	33	34
Liquid lost cc.	None	None	22	31

These four cells were in the same battery and are inter-comparable.

Cell No.	49–50*	45*–46	53*–54	44*–43	55*–56	103A–103B*
Liquid lost cc.	38–72	20–54	20–66	18–100	68–92	122–88

Above figures obtained after charging on November 5. Although the figures for Cells 49–50 seem inconsistent with the others, they are the amounts recorded.

Cell No.	49–50*	45*–46	53*–54	44*–43	55*–56	103A–103B*
Liquid lost cc.	44–0	12–38	0–42	0–52	0–32	28–0

Above figures obtained after charging on November 6. To see how the levels would change in the above tabulated cells when these batteries were allowed to stand overnight without charging, on November 7 the liquid levels were again adjusted to the original level. The following amounts of water were required.

Cell No.	49–50*	45*–46	53*–54	44*–43	55*–56	103A–103B*
Liquid drop cc.	42–46	22–28	0–0	26–22	34–32	34–34

These figures give some credence to the belief that differences in water requirements were not due to the amount of gas caught between and under the plates. The gas referred to here is not that caught in the plate pores.

Note above cells are grouped two in a battery as indicated. Compare cells in same battery—but do not intercompare batteries.

(*f*) Under identical conditions of charge, treated cells operated 1 to 3 degrees Centigrade (1.8 to 5.4 degrees Fahrenheit) cooler than did untreated cells.

This fact is substantiated by Table III, made up of data chosen from the Appendix. Treated cells are indicated by an asterisk. As before, comparisons must be made between cells in the same battery and not between batteries.

Table III

Cell No.	4–5*	6–7*	41–42*	47*–48
Temp. °C.	33.8–29.8	27.8–28.9	38–33	32–36

Cell No.	51–52*	53*54	55*56
Temp. °C.	28–29	27–32	34–35

An interesting fact about this temperature difference is brought out by Table IV in which rather extensive temperature readings are recorded for Cells 31–32–33–34, all in the same battery.

Table IV

First Charge on Cells 31–32–33–34.

A general observation that during this charge treated cells ran about 2° C. cooler than untreated cells.

Second Charge:

Cell No.	31*	32*	33	34	Time
Temp. °C.	25	24	27	26	2:25
	26	25	28	28	2:32
	28	27	30	30	2:45
	32	31	31	30	3:32
	35	34	34	34	4:57

On charge three days later (October 31):

Cell No.	31*	32*	33	34
Temp. °C.	30. 8	30. 8	31. 6	32

Cell No.	31*	32*	33	34
Temp. °C.	33	33	34	34

From Table IV the conclusion might be drawn that the difference in temperature during charge between treated and untreated cells became smaller when both cells had been charged and discharged enough to correct chemical deterioration. It was previously pointed out under the discussion on capacity that the untreated cells in this group appeared to have recovered sufficiently because of their small capacity and repeated charging, so that they differed but little from the treated cells. The temperatures for October 31 and November 3 as compared with those on Second Charge gives some indication of this effect. It would possibly have been desirable to have read all temperatures for the nearest tenth degree, but since only a difference was of interest and since it was anticipated offsetting effects might influence temperature readings, more precise readings were not made.

(*g*) During charge, and starting with discharged cells, treated cells gave higher hydrometric readings than untreated cells, the differences being greater than can be explained on the basis of the treating material added. Table V, based on the laboratory data, substantiates this fact. Treated cells are indicated by an asterisk.

Table V

Cell No.	17	18	19	20*	21	22*	All in one battery
Gravity	1160	1140	1175	1220	1145	1175	

Cell No.	23	24*	25	26*	27	28*	All in one battery
Gravity	1200	1235	1200	1225	1200	1200	

Taken on charge November 5:

Cell No.	49–50*	45*–46	53*–54	47*–48
Gravity	1050–1100	1110–1050	1110–1050	1140–1050

Cell No.	44*–43	55*–56	103A–103B*
Gravity	1105–1050	1080–1050	1050–1120

Taken on charge November 6:

Cell No.	49–50*	45*–46	53*–54	44*–43
Gravity	1090–1130	1175–1120	1175–1100	1150–1050

Cell No.	55*–56	103A–103B*
Gravity	1125–1100	1150–1175

The effect on gravity of adding the specified amount of the additive was determined as follows:

To 550 cc. of 1300 acid (approximately the amount required to bring liquid level to proper height in one cell of a group I passenger car battery) the specified amount of additive was added. When done in a graduate, not in the cell—this caused the gravity to rise to 1320 at room temperature.

When the specified amount of additive was added to one cell of a new Beacon 90-ampere-hour battery made by Gould National, the gravity rose from 1250 to 1260.

Cells 41 through 56 required approximately 800 cc. of electrolyte to bring liquid to proper level. One would conclude that in these cells addition of additive would cause the gravity to rise less than the 10 points found in the case of the Beacon battery.

(*h*) When AD–X2 was added to a cell containing a diluted electrolyte, as in a discharge cell, the conductivity of the electrolyte increased.

This result is a direct consequence of adding an ionizable material to the electrolyte (such as magnesium or sodium sulphate). Provided such added material introduces no deleterious effects, it would seem that the desirability of this effect would be above criticism, and certainly the result itself could be predicted without recourse to laboratory experiments.

Twice during the laboratory experiments, this effect was noted once during the first experiments on Cells 1–2–3 when, on adding the additive while the cells were on charge, the voltage across the cell treated suddenly dropped, and the current through the whole battery rose (see Appendix).

On October 31, Cells 41 through 56, together with 6 as of that date unnumbered cells, were put on charge. With the charger available operating at its highest voltage, less than 1 ampere flowed through the cells. When additive was put in five of the cells, more than 5 amperes could be passed through the series of cells.

LIMITATIONS OF LABORATORY RESULTS

The difficulty of duplicating in the laboratory results obtained in the field is well recognized in engineering work. The laboratory evaluation of a material such as AD–X2 is further complicated by the great variation in the samples subjected to test, even though every effort be made to so select test units as to minimize such variation. Usually, an evaluation of how a product will act under field conditions can be obtained only after extensive laboratory experimentation. Even after such experimentation, it is common practice in engineering work to subject products to field tests. How a given innovation will perform under use conditions is the true test of its worth. For this reason, laboratory findings must be supplemented by field use data if a true evaluation is to be obtained.

7. Experimental Procedure

(A) SELECTION OF SAMPLE

Even new storage batteries show considerable variation, and when one realizes that the tests herein reported were made on partially deteriorated batteries, the difficulty of selecting a representative sample becomes even greater. It is relatively easy to obtain discarded batteries, but usually a discarded battery has deteriorated to such a degree, perhaps because of the development of mechanical defects due in considerable degree to chemical deterioration, that treatment with an additive would yield no beneficial effects.

A desirable sample for these tests would be made up of a series of cells, all of which had been subjected to the same past history, but none of which had developed so-called mechanical defects. Moreover, such a sample should have experienced chemical deterioration of the type usually referred to as sulphation. Unfortunately it is common practice to try to offset chemical deterioration by prolonged charging. Without doubt, this often occurs when an automobile battery begins to deteriorate chemically. Without resorting to preparation of a specially deteriorated sample, which would require several months, the only alternative evident was to obtain new batteries, all of which had had the same past history, and all of which had stood for extended periods of time with the electrolyte in them, in a discharged condition, but had not been subjected to periodic attempts at recharging. The only cells really fulfilling these requirements were those from Nos. 41 to 56.

So that undesirable variation would not be introduced by the test procedure, the various batteries, although subjected to different conditions of charge and discharge, were so handled experimentally that all of the cells in any given battery received as far as possible the same treatment.

An additional troublesome point in the proper selection of a sample was the development of a method for finding cells having mechanical defects before the actual test procedure started, and without introducing changes in the cells because of the selection procedure. It was finally decided that a relatively short charge of 15 minutes to 1 hour at a rate of 2 to 5 amp., followed by a discharge at a moderate rate, offered the most hope for eliminating defective cells. This method did not serve too satisfactorily, since often a cell which showed no ability to store energy on the short charge-discharge cycle, on a longer test cycle, proved to be in satisfactory condition for test. However, among cells chosen as satisfactory for test, the preliminary test procedure did give a fairly good indication of the relative conditions of the various cells in any one battery.

Throughout the tests, the general tendency was not to treat with the additive those cells which showed up best in any one battery, but rather to reserve for treatment the poorer cells.

(B) PREPARATION OF THE SAMPLE FOR TEST

In most cases, the batteries to be selected for test were opened, the plates examined—particular attention being paid to cracked positive plates—and new separators were installed. Short circuits between the cells in a given battery container were checked, particularly if the container was of composition rather than hard rubber. Wherever practical, an empty cell pocket was left between treated and untreated cells to ensure that there was no leakage between the two kinds of cells, and also to serve as heat insulation to prevent temperature equalization between treated and untreated cells.

Since the cells chosen for test were sulphated, there was some question as to what electrolyte should be added to the cells. In practically every case, if the cells still contained the original electrolyte and the sulphate which would be released from the plates on complete charging, a sufficiently high gravity would be attained to meet the manufacturer's specifications. In such cases, only distilled water was

added to make up the electrolyte level. Where the cells contained none of the original electrolyte, the general procedure of adding a sulphuric acid-water electrolyte of 1100 gravity was followed. Had these cells been fully charged, it is quite probable that eventually the gravity of the electrolyte would have exceeded the manufacturer's specifications, and it would have been necessary to withdraw electrolyte and substitute distilled water. In none of the tests was charging carried far enough to make such an adjustment necessary.

(C) TEST METHODS

Charging Conditions

All cells in any given battery were charged in series to ensure that the same number of ampere hours passed through each cell in the battery. Where individual cells were not dead before charging started, they were brought to a dead condition by discharging to a point where on direct short through an ammeter less than 1 ampere was indicated on the meter, the full-scale reading being 25 amperes.

(D) DISCHARGE CONDITIONS

During discharge each cell in a given battery was discharged individually, and every attempt was made to have the discharge rate the same for each cell. No particular attempt was made to have the conditions the same in all batteries during either charge or discharge, although to a very rough approximation, conditions were comparable for most batteries tested.

(E) INSTRUMENTS

In the early experiments batteries were charged by means of a variable voltage selenium rectifier, capable of supplying up to 10 amperes at 9 volts. In later experiments a "Lemco" double unit service station charger was employed. Each unit could deliver up to 6 amperes at approximately 100 volts. Voltage was adjustable in several steps. During charging when using the "Lemco" unit, current was measured by the rather crude ammeters built into the charging unit. When using the selenium rectifier, the rate of charge was indicated by inserting a small Weston ammeter directly in the charging circuit. Discharge voltages were measured on one of two large voltmeters reading 15 volts at full scale. Readings could be made to the nearest tenth of a volt and estimated to five-hundredths of a volt. Amperage during discharge was measured on either one of two large ammeters, the full-scale reading on each being 100 units. By a series of shunts either meter could be made to read 5 amperes, 25 amperes, or 75 amperes full scale. No attempt was made to determine the absolute accuracy of the various meters used since for the tests in question relative readings were sufficient. But of those used for the discharge experiments, the two ammeters were adjusted to read the same over that part of the scale used as were also the two voltmeters.

For the measurement of gravities ordinary service station hydrometers were employed, one hydrometer being used for treated cells the other for untreated. For measuring a few gravities below 1100, a float in a graduated cylinder was used. The two hydrometers on

checking were found to read the same and the additional float was found to check the two hydrometers at the 1100 point.

Temperatures were measured with ordinary laboratory thermometers, all thermometers used being checked against each other at room temperature. Only those which gave the same reading under these conditions were used.

Discharge Resistances

To control the current on discharge, variable nichrome slide wires capable of carrying 10 amperes, 50 amperes, and 100 amperes were used. Except when voltages were falling rapidly during discharge, the discharge rate could be kept constant within approximately 1/10 of an ampere without difficulty.

(F) TESTS EMPLOYED

Capacity Test

The various capacities of the cells in a chosen battery were determined by subjecting each cell in the battery after identical charge conditions to identical discharge conditions, discharge being carried to one volt in the case of each cell. The relative lengths of time to reach a potential of one volt were taken as relative measures of the amounts of energy recoverable from the cells on initial discharge.

Recovery Tests

It is well recognized that a storage battery if rapidly discharged and then allowed to stand will yield additional energy because of a recovery process which occurs. During this recovery it is assumed that either material on the interior of the plates or electrolyte not available for use in the first rapid discharge becomes available as the cell is allowed to stand on open circuit. This recovery phenomenon can be observed several times before the cell is completely discharged. The recovery tests were made in much the same way as original discharge tests and in every case as nearly as practical after the cells in any given battery had stood for the same periods of time. To this end, when two treated and two untreated cells were to be tested for recovery from the same battery, discharge, to measure recovery, was carried out with treated and untreated cells alternating in the order of tests.

Temperature Measurements

Temperatures were measured during charge by inserting thermometers directly into the electrolyte above the plates. Satisfactory temperature measurements could be made only in those instances where either a large portion or the whole cover had been removed from the cell. It was deemed impossible to remove covers from the airplane-type batteries tested without seriously injuring the batteries themselves. Therefore, no temperature measurements were made on these cells nor on some of the automobile-type batteries tested.

Liquid Loss

Liquid loss during charge was determined by first bringing all the cells to be tested to the same liquid level, the level in the case of most of the cells tested being determined by the sharp edge of the ledge cast into the container as a seat for the cell cover. After charge, liquid loss was measured by noting the number of cubic centimeters of distilled water required to once more bring the liquid level to the

sharp ledge edge. This method was thought sufficiently accurate for determining the liquid loss.

(G) VISUAL OBSERVATIONS

In every case where cells under test were either in transparent containers or had had the tops removed so that the complete surface of the electrolyte was visible, marked differences in appearance were noted during the charge period between treated and untreated cells. Gas evolution from treated cells was in the form of almost pinpoint bubbles—in some cases the bubbles drifting to the surface, rather than rising, in almost cloudlike formation. These bubbles broke through the surface with very little surface disturbance, as contrasted with the much larger bubbles which rose rapidly through the untreated cells and broke through the surface with considerable spattering. The surface itself on the treated cells presented a different appearance than the electrolyte surface on the untreated. On the treated cells, this surface appeared more viscous, and in some instances almost dusty.

Repeatedly, the negative plates on treated cells were found to be considerably softer than corresponding plates on untreated cells from the same battery. Sometimes the soft areas were concentrated near the edges of the plates, and sometimes soft areas were fairly well distributed across the plate surface. The differences were readily noted by using a thumbnail as a sort of miniature plough to scoop up the softened surface. Under the same conditions, the hardened areas on an untreated negative plate could not be ploughed up.

In one of the first cells treated several months before this particular set of tests was started, well over an inch of sediment at the bottom of the glass case containing the cell disappeared, leaving behind a layer less than ⅛ of an inch thick, composed almost entirely of large flakes of sediment. A similar decrease in the amount of sediment was noted in four other glass-cased cells which were treated prior to the start of these tests. All five of these cells, however, were under constant observation throughout the tests herein reported.

(H) INCREASED CONDUCTIVITY OF DISCHARGED CELLS

It sometimes happens in a completely discharged cell that the electrolyte becomes so poor a conductor as to prevent a series of such cells from being charged on a charger of limited voltage range. Under such conditions, the addition of a material such as AD–X2 which will form a conducting solution cuts down the resistance of the cells sufficiently so that current can pass through the cells and the charging process be carried out, whereas otherwise it would be impossible, or at least require excessively long periods to build up sufficient conductivity to allow reasonable charging currents to pass. This phenomena seems to be fairly well recognized by battery workers.

8. Statistical Analysis of Results

A series of experiments to test the effect of AD–X2 on storage batteries were conducted by Prof. H. C. Weber, and after the ex-

periments were completed, the data were submitted to us for statistical analysis. With the exceptions of relative bubble size, which was estimated visually, and softness, for which the fingernail test was used, the data were instrument readings and therefore quantitative. Because the individual batteries could not be considered comparable one to another, treated and untreated cells from the same battery were compared, but no comparisons of instrument readings between cells from different batteries were attempted.

Restricting the analysis to within-battery comparisons does not eliminate all of the obstacles to a statistical appraisal of significance. Most statistical techniques depend upon some reasonable hypothesis as to the probability distribution of the measurements under consideration. Lacking previous experience with storage batteries, we cannot draw upon past experience as to some of the distributions involved, nor can we obtain sufficient information to estimate them from the data at hand. For this reason we have often employed nonparametric techniques to obtain estimates of significance. Since these are usually less sensitive than tests based upon specific distributions, the results would have been more impressive rather than less had parametric tests been available.

In several cases we have given more than one estimate of probability in order to compare the degrees of significance obtainable under hypotheses of varying degrees of generality.

We shall now consider the individual conclusions drawn by Professor Weber as a result of his observational data:

(*a*) "Among the cells in any chosen battery, all cells in such battery having been subjected to the same previous history, except for treatment with AD–X2, treated cells showed larger capacities than did untreated cells, both being subjected to the same conditions of discharge."

In Professor Weber's data there are 11 paired comparisons which may be made on individual batteries. In some of the cases, he considered the result of one discharge and in others as many as four discharges. It is obvious from this that the amount of experimentation done on any one battery was a function of the results that he was obtaining as he progressed. This produces in all probability a set of data on nonhomogeneous situations, and also some amount of intercorrelation between the values found. For that reason we decided to use the results on the first discharge unless both or one of the batteries was "dead." In the latter event we would consider as part of the data to be analyzed the first discharge which had nonzero values for both of the cells. In table I we give the two cells which were paired and the number of the discharge for which both values were different from zero. The actual time to discharge for both the treated and the untreated cells is given, and the last column shows the difference, which is positive if the treated cells (denoted by *) stood up for a longer time.

TABLE I.—*Discharge Data*

A. PAIRS ONLY

Pair	First Registering Discharge	Time in Minutes		Difference
		Treated (*)	Untreated	
4, 5*	1	55. 00	6. 00	49. 00
6, 7*	1	15. 00	8. 00	7. 00
15*, 16	1	9. 50	10. 33	−. 83
29, 30*	1	75. 25	46. 50	28. 75
43, 44*	1	12. 50	4. 00	8. 50
45*, 46	2	19. 75	9. 00	10. 75
47*, 48	3	28. 00	5. 00	23. 00
49, 50*	2	11. 75	7. 17	4. 58
51, 52*	1	8. 75	11. 50	−2. 75
53*, 54	1	30. 50	0. 50	30. 00
55*, 56	1	2. 08	1. 00	1. 08

B. MULTIPLE CELLS

Cells	First Registering Discharge	Average Time in Minutes		Difference
		Treated (*)	Untreated	
1, 2*, 3	1	33. 00	31. 25	1. 75
17, 19, 20*, 21, 22*	1	28. 37	28. 58	−. 21
23, 24*, 25, 26*, 27, 28*	1	22. 33	18. 61	3. 72
31*, 32*, 33, 34	1	14. 29	6. 30	7. 99

Since the basic concept of significance testing is fairly simple, we shall review the general ideas before proceeding further. As soon as it is admitted that experimental results of a certain type need not all be in the same direction or constant in magnitude, there arises at once the question as to whether a particular set of observations reflect anything more substantial than drawing lots. If it can be shown that the probability of getting results of a given kind at random is not more than 1 in 20, statisticians say that the outcome is statistically significant, and if the probability is not more than 1 in 100, they say the outcome is highly significant.

To estimate the probability of getting a certain kind of result by chance, statisticians try to formulate a mathematical situation on a par with drawing lots. Of the possible tests of significance which can be applied to experimental data without presupposing knowledge of the distributions involved, we have chosen two, which are conceptually simple. In both tests, the lot-drawing hypothesis would have it that treatment with AD–X2 has no beneficial effect on battery performance, and that the asterisks might just as well have been assigned without reference to treatment. In these tests, as well as others to be described later on, we compute the probability of obtaining results this favorable or more favorable to the use of AD–X2 if the asterisks were no more pertinent to the outcome than flipping a coin.

In the first test we ask the question: "If the asterisk were nothing more than an arbitrary label assigned at random to one cell in each battery (implying that the observed differences of discharge time were due to chance alone), what is the probability that we shall observe at least as many as 9 positive differences?" In other words, what is the probability of obtaining 9, 10, or 11 positive differences in a random draw of 11 pairs? The answer is that the probability is only about .03. That is, we should expect results this favorable (9 positive differences) or more so (10 or 11 positive differences) about 3 times in 100 similar experiments.

The second test of significance is nonparametric also but involves the use of the magnitude of the numbers involved. Once again the asterisks are assigned at random for the two cells within each battery. In this case all possible sums for the differences between the treated and untreated cells are computed for every conceivable arrangement of asterisk and nonasterisk in the 11 pairs. The number of ways that a sum of the total differences for the 11 pairs can be as great as or greater than the one observed is then compared to the total number of possible sums. The ratio of these two numbers represents the probability of the occurrence of the event. In our case there are 6 ways that we can rearrange the asterisk and the nonasterisk cells in order to obtain a sum which is as great as or greater than the one observed. The total number of possible sums is 2,048, and therefore the probability P of obtaining a total sum for the 11 differences at least as great as was observed is P=.003 approximately, which is, of course, 3 chances out of 1,000. To facilitate the verification of our computations, we have presented the details in Table II and Exhibit I, which will be found at the close of this section.

This method explained in the previous paragraph seems to us to be the one which is less subject to criticism as far as the choice of data is concerned and seems to represent most fairly the probability involved. We do not feel that any estimates can be made of the actual superiority of the treated cells over the untreated cells percentagewise or in actual magnitude, because of our lack of knowledge as to the distribution of potential observations or inherent variability between cells within a battery and between batteries in the condition for which this treatment might be effective. However, since this analysis does indicate that it is very unlikely that differences such as were observed occurred by chance, it is reasonable to suppose that there must have been a favorable effect from the AD–X2. Whether or not this effect is great enough to be of commercial value is something that must be determined from field experiments both as to the percentage of batteries which are appreciably improved and as to the magnitude of that improvement.

Although we feel that the following analyses are not as justified as the preceding one, we give them here for anyone who might be interested. If only those 8 pairs which yielded a reading other than zero on the first discharge are considered as the entire legitimate evidence, then a probability of obtaining 6 positive and 2 negative signs, assuming the asterisk and the nonasterisk are distributed at random, is P=.144. We can also, of course, proceed as was done in the beforementioned analysis and calculate the probability of obtaining a sum as great as or greater than the one actually observed, assuming that the asterisks were distributed at random inside the batteries. Here the probability is P=.023. To us, this procedure does not seem to be fair, inasmuch as other experiments are available which involve the first discharge only, but they involve 3, 4, 5, and 6 cells respectively for individual batteries. It would then seem logical to utilize all of the first discharges by averaging the asterisk cells and the nonasterisk cells in each battery and subtracting one average from another if they were merely paired measurements similar to the previous data. This introduces a degree of nonhomogeneity into the data itself, but it is the best that can be done with information on the first discharge, if we are going to restrict ourselves to that. The probabilities for

the sign test are P=.073 assuming that the 8 pairs available on the first discharge and the 4 remaining comparisons available from batteries with more than two cells tested are combined in one sample. We can also apply the test of magnitude and find that the probability there is P=.005.

It is of interest to note further that if all the data were combined (that is the original 11 pairs, as given in Table I, plus the data on 4 batteries where more than two cells are tested) the respective probabilities are P=.018 in the case of the sign test and P=.0006 in the case of the magnitude test. These additional probabilities merely corroborate what we considered to be the preferred analysis.

TABLE II.—*Listing of Differences in Order of Magnitude*

Discharge 1		Discharge 2 or 3
Pairs	Multiple Cells	Pairs only
	−. 21	
−. 83		
1. 08		
	1. 75	
−2. 75		
	3. 72	
		4. 58
7. 00		
	7. 99	
8. 50		
		10. 75
		23. 00
28. 75		
30. 00		
49. 00		

EXHIBIT I.—COMPUTATION OF PROBABILITIES

First Discharge

Pairs Only (Negative Total=−3.58)

1. MAGNITUDE TEST

Better	All signs+	1 Way
Better	One Sign−	3 Ways
Better or Same	Two signs−	2 Ways
	Total	6 Ways

$$\text{Probability}=\frac{6}{2^8}=\frac{3}{2^7}=\frac{3}{128}=.023$$

2. SIGN TEST

Better	All signs+	1 Way
Better	One sign−	8 Ways
Same	Two signs−	28 Ways
	Total	37 Ways

$$\text{Probability}=\frac{37}{2^8}=\frac{37}{256}=.144$$

First Discharge—Continued

Pairs and Multiple Cells (Negative Total=3.79)

1. MAGNITUDE TEST

Better	All signs+	1 Way	
Better	One sign−	6 Ways	
Better	Two signs−	8 Ways	(4+3+1)
Better or Same	Three signs−	5 Ways	(3+1+1)
	Total	20 Ways	

$$\text{Probability}=\frac{20}{2^{12}}=\frac{20}{4096}=.0049$$

2. SIGN TEST

Better	All Signs+	1 Way
Better	One Sign−	12 Ways
Better	Two Signs−	66 Ways
Same	Three Signs−	220 Ways
	Total	299 Ways

$$\text{Probability}=\frac{299}{2^{12}}=\frac{299}{4096}=.0730$$

First Registering Discharge

Pairs Only

1. MAGNITUDE TEST (NEGATIVE TOTAL=−3.58)

Better	All Signs+	1 Way
Better	One Sign−	3 Ways
Better or Same	Two Signs−	2 Ways
	Total	6 Ways

$$\text{Probability}=\frac{6}{2^{11}}=\frac{3}{2^{10}}=\frac{3}{1024}=.0029$$

2. SIGN TEST

Better	All Signs+	1 Way
Better	One Sign−	11 Ways
Same	Two Signs−	55 Ways
	Total	67 Ways

$$\text{Probability}=\frac{67}{2^{11}}=\frac{67}{2048}=.032$$

Pairs and Multiple Cells (Negative Total=−3.79)

1. MAGNITUDE TEST

Better	All Signs+	1 Way	
Better	One Sign−	6 Ways	
Better	Two Signs−	8 Ways	(4+3+1)
Better or same	Three Signs−	5 Ways	(3+1+1)
	Total	20 Ways	

$$\text{Probability}=\frac{20}{2^{15}}=\frac{20}{32768}=.0006$$

First Registering Discharge—Continued

2. SIGN TEST

Better	All Signs+	1 Way
Better	One Sign−	15 Ways
Better	Two Signs−	105 Ways
Same	Three Signs−	455 Ways
	Total	576 Ways

$$\text{Probability} = \frac{576}{2^{15}} = \frac{576}{32768} = .0176$$

NOTE.—No allowance was made for fact that treated cell 52 was found to have four cracked positives nor for fact that the poorer cells were chosen for treatment.

(*b*) "When AD–X2 was added to cells containing sediment, the amount of sediment decreased both while the battery was on charge and when it was not on charge."

Although the empirical evidence supports this statement, we cannot perform a statistical test on these data.

(*c*) "Cells treated with AD–X2 when on charge presented a markedly different appearance from those on charge without treatment. The gas evolved in the treated cells was in the form of minute bubbles, while that evolved in the untreated cells was in bubbles estimated to be 4 to 10 times as large as those evolved in the treated. The liquid surface in the treated cells presented a different appearance from that in the untreated cells."

As evidence of this statement results on the following cells are given in the Appendix: 31*, 32*, 33, 34, 43, 44*, 45*, 46, 49, 50*, 53*, 54, 55*, 56, 103A, 103B*. This gave a total of 16 observations, eight on the treated cells and eight on the untreated. However, 53* and 54, could not be observed internally because of the casing, and therefore this leaves 14 available observations for analysis. Since it is reasonable to assume that previous history in the form of length of time of charge, number of discharges, etc., are not pertinent here, we have used the ordinary 2x2 contingency table with the exact probability of the arrangement computed.

	Treated	Untreated	Total
Small Bubbles	7	0	7
Large Bubbles	0	7	7
Total	7	7	14

The exact probability of the occurrence by chance of the above arrangement with the given marginal totals can be computed as follows:

$$P = \frac{7!\ 7!\ 7!\ 7!}{7!\ 0!\ 7!\ 0!\ 14!} = \frac{1}{3432} = .00029$$

Since this probability is extremely small, there is no doubt that there is considerable association between the small bubbles and the treated cells.

(*d*) "The surface of a negative plate in a treated cell was distinctly softer than the surface of a similar plate in an untreated cell, both having been subjected to the same charge conditions. Often, softening was first evident near the edges of the negative plate."

As evidence of this statement results of the following cells are given in the Appendix: 4, 5*, 6, 7*, 51, 52*, 53*, 54. All of the cells that were treated showed that the sulphate was 'soft' while in the case of the untreated cells the sulphate was hard and therefore the ordinary 2 x 2 contingency table used in (*c*) should also be appropriate as follows:

	Treated	Untreated	Total
Hard	0	4	4
Soft	4	0	4
Total	4	4	8

$$P=\frac{(4!)\ (4!)\ (4!)\ (4!)}{8!\ 0!\ 4!\ 4!\ 0!}=\frac{1}{70}$$

Although this probability is somewhat larger than that in (*c*) due to the fact that a smaller number of observations were available for analysis, there exists a significant association between the soft plates and the treated cells. However, one can certainly not conclude from this small amount of data that the treatment will always produce a plate which is softer than one not treated in the same battery.

(*e*) "Under similar charge conditions, treated cells lost less liquid than untreated cells."

The following data are presented by Professor Weber to corroborate the above statement, and the differences in Table III are the treated cell liquid loss minus the untreated:

TABLE III.—*Liquid Loss*

Pair	Nov. 5 Difference	Nov. 6 Difference
43, 44*	82	52
45*, 46	34	26
49, 50*	−34	44
53*, 54	46	42
55*, 56	24	32
103A, 103B*	34	28

A conclusion on this set of data is not particularly obvious. It would seem that the duplicate run from November 5th to November 6th would not materially increase the information since a cell which is losing water on one day would probably lose it the next with about the same order of magnitude. The difference between 50* and 49 on November 5th is negative, and Professor Weber believes that this is an interchange of the two values in writing them in his notebook. This would seem a logical conclusion, inasmuch as the loss of water in these two cells should be in the same direction on the second day, irrespective of whether or not the AD–X2 was effective. If we consider the sign test alone on November 5th, the probability of obtaining five or more positive differences, assuming the asterisks were assigned at random, would be $P=\frac{7}{64}$, and the magnitude test would yield about the same result, namely, a probability of $P=\frac{5}{64}$, since there are three 34's all of which can bear the negative sign without increasing the sum. Neither of these probabilities can be considered as significant. If November 6 were considered the data on which the conclusions were to be drawn, the probability of both the sign and the magnitude test is $P=\frac{3}{64}$, which would reverse the decision. Neither of these

techniques, of course, takes into account the possible distribution of the measurements. Since a measurement in the difference of level in the liquid is much more likely to be distributed in a manner for which ordinary statistical techniques would apply such as testing the hypothesis that the mean difference is greater than zero, we have computed the variation of the mean difference from zero in terms of the standard error of this difference on the basis that the mean difference normally distributed. This is commonly known as the "t" test, and in our case it is that statistic based on five degrees of freedom. The value of t for November 5th is t=2.01, and utilizing a one-sided hypothesis the probability is P=.051, which is on the borderline of significance. On November 6th, t=8.92, the probability of which is very much smaller than one in a thousand and thus is highly significant. Unfortunately, these two estimates cannot be combined because the amount of dependence cannot be reliably estimated. It would appear to us that more independent data should be obtained if there is doubt as to the −34. On the other hand, the very significant result obtained on November 6th lends credence to Professor Weber's belief that he made a clerical error in recording the difference between 49 and 50* on November 5th.

(*f*) "Under identical conditions of charge, treated cells operated 2 to 5 degrees Fahrenheit cooler than untreated cells."

Referring to Table IV of Professor Weber's text, it seems fair to assume that the operating temperature difference is a function of time, and that both treated and untreated cells will eventually approach the same temperature. This fact contrasts with the conditions of the previous conclusions, which did not seem to be systematically dependent upon time. There is not enough data to enable us to make a reliable estimate of the temperature difference as a function of time, and for this reason we do not believe that a statistical test based on the magnitude of the difference would be legitimate. This forces us to confine our analysis to the sign test, which, of course, is not very sensitive; and because of its insensitivity, we can fail to establish the significance of an effect which actually exists. Relevant data are shown in our Table IV below:

TABLE IV.—*Temperature Differences*

Pair	Difference
4, 5*	4
6, 7*	−1
41, 42*	5
47*, 48	4
51, 52*	−1
53*, 54	5
55*, 56	1

The differences recorded in Table IV were obtained by subtracting the temperature of the treated cell from the temperature of the untreated cell. In seven pairs the difference was positive five times, and by the sign test there are 29 chances of obtaining a result this favorable or more so in 128 trials; therefore the probability is P=.227. This value is certainly not statistically significant. In order to establish Professor Weber's conclusion (*f*), it would be necessary to obtain more data; and in doing so it would be advisable to take temperature readings at equal intervals of time.

(*g*) "During charge, and starting with discharged cells, treated cells gave higher hydrometric readings than did untreated cells, the differences being greater than could be explained on the basis of treating material added."

The data presented to substantiate this statement is enclosed in Table V where the differences tabulated are the excess of the treated cells over the untreated as follows:

TABLE V.—*Hydrometric Differences*

Pairs	Difference	
	November 5	November 6
43, 44*	55	100
45*, 46	60	55
47*, 48	90	Not Done
49, 50*	50	50
53*, 54	60	75
55*, 56	30	25
103A, 103B*	70	25

In the text Professor Weber noted that of these excesses about only 10 points could be associated with the addition of AD–X2 due to its own physical properties apart from its operation as a reagent. Therefore all of the magnitudes noted in the table are still definitely positive when any number in the neighborhood of 10 is subtracted from each, and a "t" test would show a significant increase. However, without making any hypothesis regarding the distribution, the probability of getting 7 positive differences on November 5th is $P=\frac{1}{128}$ which is highly significant. If one wished to include the data on November 6th as independent data (which would be erroneous, since some dependence is evident), $P=\frac{1}{8192}$. The true significance of this arrangement is somewhere between these two figures, and it is not worthwhile to try to take account of the dependence since the former value is already significant.

(*h*) "When AD–X2 was added to a cell containing a diluted electrolyte, as in a discharged cell, the conductivity of the electrolyte increased."

The observations were not taken in such a manner as to make a statistical analysis feasible under any hypothesis which seems to us defensible.

It may seem peculiar that with the significance we have found in many of these experiments showing that the effect of AD–X2 is real, we have not given any estimates of the possible effectiveness and limits within which we might expect these estimates to lie. There are two reasons for this. First, it seems to us that in order to make statements of that nature, it is essential to acquire considerably more knowledge of the form of the distributions of the behavior of batteries in general regarding the measured attributes. Second, we have no direct data on interbattery differences when AD–X2 is added to some batteries and not to others. Nevertheless, it has been established under the controlled conditions of this experiment that the addition of AD–X2 has changed on the average the performance of the individual cells as regards many of their attributes.

9. STATEMENT OF SUPPORTING SCIENTIFIC AUTHORITY

DECEMBER 8, 1952.

Professor HAROLD C. WEBER,
Massachusetts Institute of Technology.

DEAR PROFESSOR WEBER: During the first part of November 1952, I made, at the request of President Killian, some observations and a few experimental studies on the effect of a battery additive AD–X2 on lead acid storage batteries. The work was done in your laboratory, on storage cells selected by me from a group of batteries in your possession. In addition, I observed your work during this period.

The following statements are made concerning the report, "Some Facts Concerning the Effect of Battery Additive AD–X2 on Lead Acid Batteries," by Harold C. Weber and dated December 1, 1952.

1. *Sampling.*—In a laboratory test extending over a relatively short time, the cells used for testing must necessarily come from batteries that have been discarded or from batteries that have stood for a long time in a discharged state. The latter, although preferable, are usually not available. Discarded batteries have frequently developed mechanical defects to a greater or less extent in one or more cells. For this reason, valid conclusions cannot be drawn from the comparison of one complete battery against another unless a large number of samples are studied. A smaller number of samples would be required in the method used by you where a comparison is made between a treated and an untreated cell taken from the same battery. However, even in this method, many tests are necessary to determine the effect, beneficial or otherwise, of a battery additive. Definitive conclusions can only be drawn from laboratory test extending over long periods of time or from extensive field tests.

2. *Summary of Results.*—I observed the following facts concerning the results listed in your Paragraph 5.

(*a*) "Among the cells in any chosen battery, all cells in such battery having been subjected to the same previous history, except for treatment with AD–X2, treated cells showed larger capacities than did untreated cells, both being subjected to the same conditions of discharge."

In the experiments I made or observed, this was true except for two treated cells that would not take a charge. Both were found to have broken separators.

(*c*) "Cells treated with AD–X2 when on charge presented a markedly different appearance from those on charge without treatment. The gas evolved in the treated cells was in the form of minute bubbles, while that evolved in the untreated cells was in bubbles estimated to be 4 to 10 times as large as those evolved in the treated. The liquid surface in the treated cells presented a different appearance from that in the untreated cells."

This striking difference in behavior was observed in every cell I studied or observed. The gas evolved in the treated cells was in the form of bubbles so small that they did not always rise to the surface of the liquid immediately, but eddied around in the liquid in swirls that gradually rose. The surface of a treated cell during and after charge seemed to be partly covered with small specks that gave the surface an oily appearance.

(*d*) "The surface of a negative plate in a treated cell was distinctly softer than the surface of a similar plate in an untreated cell, both

having been subjected to the same charge conditions. Often, softening was first evident near the edges of the negative plate."

(*e*) "Under similar charge conditions, treated cells lost less liquid than untreated cells."

(*f*) "Under identical conditions of charge, treated cells operated 2 to 5 degrees Fahrenheit cooler than did untreated cells."

(*g*) "During charge, and starting with discharged cells, treated cells gave higher hydrometric readings than did untreated cells, the differences being greater than could be explained on the basis of the treating material added."

The statements in the above four paragraphs are in accordance with my observations except for the two treated cells, mentioned earlier, that had broken separators.

In conclusion, I would say that the addition of AD–X2 certainly does have an effect on the behavior of a lead acid battery. From my brief contact with the work, I cannot say that this effect is correlated with a beneficial action from the standpoint of the normal use of such a battery. I feel that the latter can be determined only after the examination and statistical evaluation of extensive field tests.

Very truly yours,

JAMES A. BEATTIE,
Professor of Physical Chemistry.

APPENDIX TO REPORT OF MIT

Supporting Laboratory Data

These data are, with one exception, all that were collected in the laboratory tests made on AD–X2. They are here presented exactly as they appear in the laboratory notebooks, with the exception that data referring to a particular cell have been collected at one point, rather than having them arranged chronologically as they were recorded, irrespective of the particular cell being tested at any specified time. This rearrangement was followed merely to aid others in studying the data. The key to the arrangement originally practiced in the laboratory is found by referring to the dates on which the various experiments were performed. The one exception was a small amount of data collected in a preliminary way by Dr. Beattie personally to familiarize himself with the experimental techniques employed.

Data for the first 10 cells were previously reported briefly at a conference at the Bureau of Standards on September 29, 1952.

Charging of Cells 1, 2, and 3

		CELL NO. 1			CELL NO. 2			CELL NO. 3		
Time	Charge Rate	Temp.	Grav.	Volt	Temp.	Grav.	Volt	Temp.	Grav.	Volt
Sept. 16, 1952										
10:25 (1)	½ amp.	24	1100		24	1100		24	1100	
11:50	½ amp.	24	1100		24	1100		24	1100	
1:30	.75 amp.	25		2.9	25	1100	2.5	25	1100	2.9
1:40					AD–X2 added					
1:45	1 amp.			2.6			2.1			2.6
2:45	2 amp	26.5	1100	2.8	26.5	1100	2.4	26.5	1100	2.7
3:50	3.1 "	29.0	1100	2.7	29.0	1100	2.4	29.0	1100	2.6
Charged 5 hrs. 25 min.										
Sept. 18, 1952										
11:00	Not Charging	23	1100	.8	23	1100	.8	23	1100	.8
11:05	1 amp.	23	1100	3.1	23	1100	2.1	23	1100	3.1
11:40	2.5 "	25	1100	2.7	25	1100	2.4	25	1100	2.7
11:55	3.0 "	26	1100	2.7	26	1100	2.5	26	1100	2.7
1:35	4.5 "	32	1100	2.4	34	1100	2.4	32	1100	2.4
3:45	5.5 "	34		2.3	37		2.3	35		2.3
3:50	Charge stopped			1.9			1.9			1.9
Charged 4 hrs. 50 min. Room temp. Sept. 16, 24 Sept. 18, 23										

DISCHARGE

	Volt.	Amp.	Time	Volt.	Amp.	Time	Volt.	Amp.	Time
Sept. 18, 1952									
	1.9	5	4:01	1.2	5	4:15	1.6	5	4:17
	1.6		4:02	1.0		4:16	1.6		4:18
	1.5		4:06				1.5		4:19
	1.4		4:07	Cell evidently aborted			1.4		4:21
	1.3		4:10				1.3		4:22
	1.2		4:11				1.0		4:25
	1.0		4:12						
		11 min.						8 min.	

1. Original liquid in cell and water added to cover plates.
2. Cells 1 and 3 evolving large bubbles freely. No bubbles from Cell 2. Liquid level in Cells 1 and 3 raised about ¼″.
3. Cells 1 and 3 evolving gas freely. Cell 2—no gas evolution.

4. In cell 2, hydrometer floats but reading less than 1100. Some white deposit showing on edges of plates Cell 2.

These cells constructed by sawing apart a single Navy standard cell to make four small units. Three units used. Cells assembled in lucite case with open air insulation spaces between cells. Lead strips burned on the cells for connections.

These cells supplied with new separators and assembled into plastic jar used previously. Acid of 1100-gravity added. Cell 2 treated with AD–X2 before start of charging.

Cell 1 was from center of original cell and not as badly sulphated as were Cells 2 and 3. This conclusion based on visual observation.

Note these three cells were originally on charge 9/16/52 for 9 hrs. 10 min. with a short in Cell 2. This led to conclusion to install new separators. All cells were discharged, new separators installed, 1100-gravity acid added, Cell 2 treated with AD–X2, and then all three placed on charge as indicated. Note Cells 1 and 3 now have an unfair advantage over Cell 2 because of extra 9 hr. 10 min. to break sulphate—and this extra charging was carried on in (essentially) a water electrolyte—not an acid one.

Charged Cells 1, 2, and 3

		CELL NO. 1			CELL NO. 2			CELL NO. 3		
Time	Charge Rate	Temp.	Grav.	Volt.	Temp.	Grav.	Volt.	Temp.	Grav.	Volt.
Sept. 23, 1952										
4:45	4.5	25	1100	2.4	25	1100	2.5	25	1100	2.4
5:55	4.5	25	1100	2.4	26	1100	2.4	26	1100	2.4
	Charging discontinued over-night									
Sept. 24, 1952										
11:00	0	20.2	1100	1.9	20.2	1100	1.9	21.0	1100	1.9
11:02	5 amp.									
3:00	Charging stopped									

Discharge Cells 1, 2, and 3

CELL NO. 1			CELL NO. 2			CELL NO. 3		
Open Circuit Volt 2.1			Open Circuit Volt 2			Open Circuit Volt 2		
Time	Amp.	Volt.	Time	Amp.	Volt.	Time	Amp.	Volt.
3:13	10	1.9	3:52	10	1.8	4:26	10	1.8
3:15	10	1.8	3:55	10	1.8	4:35	10	1.8
3:16	10	1.8	3:57	10	1.8	4:40	10	1.8
3:18	10	1.8	4:00	10	1.7	4:45	10	1.7
3:20	10	1.8	4:05	10	1.7	4:50	10	1.6
3:22	10	1.8	4:10	10	1.7	4:51	10	1.3
3:24	10	1.8	4:15	10	1.7	4:52	10	1.0
3:26	10	1.8	4:20	10	1.5		26 min.	
3:28	10	1.8	4:21	10	1.5			
3:30	10	1.8	4:22	10	1.4			
3:32	10	1.8	4:23	10	1.3			
3:34	10	1.7	4:24	10	1.2			
3:37	10	1.7	4:25	10	1.0			
3:40	10	1.7		33 min.				
3:42	10	1.7						
3:44	10	1.7						
3:46	10	1.6						
3:48	10	1.5						
3:49	10	1.3						
3:49½	10	1.0						
	36.5 min.							

SEPTEMBER 25, 1952.

Recovery test on cells 1, 2, and 3. These cells previously discharged September 24, 1952, and have stood 19 hours without additional charging.

Cell 2 has AD–X2

Open Circuit Voltage—Cell 1, 1.9; Cell 2, 1.9; Cell 3, 1.9

CELL NO. 1			CELL NO. 2			CELL NO. 3		
Time	Amp.	Volts	Time	Amp.	Volts	Time	Amp.	Volts
11:36	5	1.8	12:00	5	1.8	12:30	5	1.7
11:37		1.8	12:01		1.8	12:31		1.7
11:38		1.8	12:02		1.8	12:32		1.7
11:39		1.8	12:03		1.8	12:33		1.7
11:40		1.8	12:04		1.8	12:34		1.7
11:41		1.8	12:05		1.8	12:35		1.7
11:42		1.8	12:06		1.8	12:36		1.7
11:43		1.8	12:07		1.8	12:37		1.7
11:44		1.7	12:08		1.8	12:38		1.7
11:45		1.7	12:09		1.7	12:39		1.7
11:46		1.7	12:10		1.7	12:40		1.6
11:47		1.7	12:11		1.7	12:41		1.6
11:48		1.7	12:12		1.7	12:42		1.6
11:49		1.7	12:13		1.7	12:43		1.6
11:50		1.7	12:14		1.7	12:44		1.6
11:51		1.7	12:15		1.7	12:45		1.6
11:52		1.6	12:16		1.7	12:46		1.5
11:53		1.6	12:17		1.6	12:47		1.4
11:54		1.6	12:18		1.6	12:48		1.3
11:55		1.5	12:19		1.5	12:49		1.0
11:56		1.3	12:20		1.4		19 min.	
11:57		1.2	12:21		1.4			
11:58		1.0	12:22		1.3			
	22 min.		12:24		1.2			
			12:25		1.2			
			12:26		1.1			
			12:26½		1			
				26½ min.				

All three cells appear to be in excellent condition by observation.

At 12:50 dead shorted all cells to eliminate inequalities in recuperation. Put on charge at 12:55 at 5 amp.

SEPTEMBER 25, 1952.

Discharge of Cells 1, 2, and 3 After Charging Till 3:30
(2 hrs. 35 minutes at 5 amp.)

Open Circuit Voltage—Cell 1, 2 volts; Cell 2, 2 volts; Cell 3, 2 volts

CELL NO. 1			CELL NO. 2			CELL NO. 3		
Time	Amp.	Volt	Time	Amp.	Volt	Time	Amp.	Volt
3:30	10	1.9	4:38	10	1.7	5:25	10	1.8
3:32		1.9	4:40		1.7	5:35		1.8
3:55		1.9	4:45		1.7	5:50		1.8
4:00		1.8	4:50		1.7	5:55		1.7
4:05		1.8	4:55		1.7	6:00		1.6
4:15		1.8	5:00		1.7	6:01		1.5
4:16		1.7	5:05		1.7	6:02		1.3
4:20		1.7	5:10		1.6	6:03		1.2
4:22		1.7	5:15		1.6	6:03½		1.0
4:25		1.7	5:17		1.5		38½ min.	
4:30		1.6	5:20		1.4			
4:32		1.5	5:21		1.3			
4:33		1.4	5:22		1.2			
4:34		1.2	5:23		1.1			
4:34½		1.0	5:24¼		1			
	44¼ min.			46¼ min.				

Note concerning Cell 2: Lug which had been burned on positive plate bank broke off near end of charge period. Could have been a bad connection during previous tests on this cell. Substitute a needlepoint connection for broken lug since no other means of connection was immediately available.

Charged Cells 4 and 5

Cells were Exide Hycap Cells from junk battery with heavily sulphated plates. New separators installed. Cells assembled in original case with center compartment empty. This was Group II battery.

1100 acid added. Cells stood over night. Gravity dropped on standing over night. Temperature cannot be read—cannot get thermometer into cell. Gravity on Cell 5 practically 1100.

Sept. 19, 1952		CELL NO. 4			CELL NO. 5		
Time	Charge Rate	Temp.	Grav.	Volt	Temp.	Grav.	Volt
9:23	5 amp.				AD-X2 added		
9:26			1100	3.0		1100	2.0
10:00				2.6			2.1
11:00			1100	2.5		1100	2.2
12:00		32.3	1100	2.4	29.2	1100	2.1
1:00		33.2	1100	2.3	29.7	1100	2.1
2:20		33.8	1100	2.2	29.8	1100	2.1

Charged 4 hrs. 57 min.

DISCHARGE

Time	Amp.	Volt	Time	Amp.	Volt
3:33	—	1.8	2:34	—	2
3:34	6	1.4	2:35	6	1.9
3:36		1.3	2:40		1.9
3:38		1.1	2:50		1.9
3:39		1	3:00		1.9
			3:10		1.9
	6 min.		3:20		1.8
			3:26		1.7
			3:29		1.4
			3:30		1.3
			3:32		1.0
				55 min.	

Tests on recovery of cells 4 and 5 previously discharged after standing 96 hours with no recharging.

CELL NO. 4			CELL NO. 5		
No AD-X2			AD-X2 added		
Time	Amp.	Volt	Time	Amp.	Volt
11:30	—	1	11:31	—	1.9
11:30	.5	0	11:32	4	1.9
			11:33		1.8
			11:34		1.8
			11:35		1.8
			11:36		1.8
			11:37		1.8
			11:38		1.8
			11:39		1.8
			11:40		1.8
			11:41		1.8
			11:42		1.8
			11:43		1.7
			11:44		1.7
			11:45		1.7
			11:46		1.7
			11:47		1.7
			11:48		1.7
			11:49		1.6
			11:50		1.6
			11:51		1.4
			11:52		1.3
			11:53		1.3
			11:54		1.2
			11:55		1.0
				24 min.	

Second discharge without recharging on cells 4 and 5 after standing 1 hr. 40 min. Cell 4 showed open circuit voltage of 1.0 and .3 volts at .2 amp.

CELL NO. 5

Time	Amp.	Volt
1:35	4	1.8
1:36		1.8
1:37		1.8
1:38		1.8
1:39		1.8
1:40		1.8
1:41		1.7
1:42		1.7
1:43		1.7
1:44		1.6
1:45		1.6
1:46		1.3
1:47		1.3
1:48		1.2
1:49		1.0

14 min.

SEPTEMBER 26, 1952.

Cells 4 and 5 were put on charge at 10:55 at 7 amps. and charged for one hour. They had previously been discharged on September 24, 1952.

CELL NO. 4

Open Circuit Volt. 1.8

Time	Amp.	Volt.
1:10	5	1.5
1:11		1.4
1:12		1.4
1:13		1.3
1:14		1.3
1:15		1.1
1:15½		1.0

3½ min.

CELL NO. 5

Open Circuit Volt. 2.0

Time	Amp.	Volt.
1:20	5	1.9
1:21		1.9
1:22		1.9
1:23		1.9
1:24		1.9
1:25		1.9
1:26		1.9
1:27		1.9
1:28		1.9
1:29		1.9
1:30		1.8
1:31		1.8
1:32		1.8
1:33		1.8
1:34		1.8
1:35		1.8
1:36		1.8
1:37		1.8
1:38		1.8
1:39		1.8
1:40		1.8
1:41		1.8
1:42		1.8
1:43		1.8
1:44		1.8
1:45		1.8
1:46		1.8
1:47		1.8
1:48		1.8
1:49		1.8
1:50		1.8
1:51		1.8
1:52		1.8
1:53		1.8
2:00		1.8
2:05		1.8
2:10		1.8
2:15		1.8
2:20		1.8
2:25		1.8
2:30		1.8
2:34		1.7
2:35		1.6
2:36		1.4
2:37		1.3
2:39		1.3
2:40		1.2
2:40¾		1.0

80¾ min.

NOTE: Cell 4 went almost as long at 5 amp. discharge after 1 hr. charge as it went previously at 6 amp. discharge after previous 5-hr. charge.

NOTE: Cells 4 and 5 stood from 9/24/52 at 1:30 P. M. till 10:55 P. M. on 9/26/52 when they were put on charge at 7 amp. for one hour.

SEPTEMBER 26, 1952.

Additional Experiments on Sulphated Untreated Cell No. 4

Cell put on charge at 2:42 p. m. at 7 amps. AD–X2 added and charged at 7 amps. till 3:40 p. m. (58 min.).

Discharge on Cell No. 4

Open Circuit Voltage 1.8

Time	Amp.	Volt.
5:05	5	1.5
5:06		1.5
5:07		1.4
5:08		1.4
5:09		1.3
5:10		1.2
5:11		1.2
5:12		1.1
5:13¼		1.0

8¼ min.

NOTE: When this Cell without AD–X2 was previously discharged after 58 min. charge at 7 amp., it went only 5½ min., as contrasted with 8¼ min. this time.

SEPTEMBER 22, 1952.

Two Autolite Cells from Group I passenger car battery. New wood separators installed, cells drained and 1100 acid added. Separators were soaked in water. Gravity at start under 1100 but hydrometer floated.

Evidence of shorting band of sulphate on both ends of Cell 7.

Cells assembled in outside sections of 3-section glass container.

Loose sulphate mud removed from between edges of plates on Cell 7 with filter paper. Same treatment given to Cell 6, although no shorting mud was in evidence. Thermometer checked and read same at same temperature.

Charged cells 6 and 7, 3 hours 20 min. at 5 amps.

Cells 6 and 7

		CELL NO. 6			CELL NO. 7		
Time	Charge Rate	Temp.	Grav.	Volt.	Temp.	Grav.	Volt.
11:40	—	24.0	1100–	1.6	24.0	1100–	1.1
11:44	4 amp.			3.4			3.3
11:46	5 amp.			3.2			3.2
11:48	5 amp.					AD–X2 Added	
11:55	5 amp.			2.8			2.7
1:54	5 amp.	27.0	1100–	2.5	28.5	1100–	2.6
3:00	5 amp.	27.8	1100–		28.9	1100–	—*

*Room Temp. 23

DISCHARGE

	CELL NO. 6			CELL NO. 7		
	Time	Amp.	Volt.	Time	Amp.	Volt.
	3:21	5	1.7	3:05	5	1.8
	3:22	5	1.7	3:07	5	1.7
Before discharge,	3:25	5	1.5	3:10	5	1.6
open circuit	3:29	5	1.0	3:15	5	1.4
voltage was 1.9				3:17	5	1.2
on both cells.		8 Min.		3:20	5	1.0
					15 Min.	

SEPTEMBER 23, 1952.

Cells 6 and 7

CHARGE

Time	Charge Rate	CELL NO. 6 Temp.	Grav.	Volt.	CELL NO. 7 Temp.	Grav.	Volt.
3:45	—	27.0	1100—	1.6	26.8	1100—	1.8
3:47	5 amp.	27.0	1100—	2.3	26.8	1100—	2.4
4:15	7 amp.		1100—	2.3		1100—	2.4
4:35	7 amp.	28.2	1100—	2.3	27.2	1100—	2.4
5:00	7 amp.	29.0	1100—	2.3	27.5	1100—	2.4

DISCHARGE

CELL NO. 6 Time	Amp.	Volt.	CELL NO. 7 Time	Amp.	Volt.
5:01	5	1.9	5:21	5	1.8
5:05	5	1.8	5:25	5	1.8
5:10	5	1.7	5:30	5	1.7
5:14	5	1.6	5:34	5	1.7
5:16	5	1.5	5:40	5	1.6
5:17	5	1.3	5:41	5	1.5
5:18	5	1.2	5:43	5	1.4
5:20	5	1.1	5:45	5	1.3
5:21	5	1.0	5:47	5	1.2
	20 Min.		5:48	5	1.1
			5:51	5	1.0
				30 Min.	

Before discharge, open circuit voltage was 2.0 on both cells.

SEPTEMBER 24, 1952.

Cells 6 and 7

Tests on recovery of Cells 6 and 7 previously discharged after standing 17 hours without recharging.

CELL NO. 6 No AD-X2 Time	Amp.	Volt.	CELL NO. 7 AD-X2 Added Time	Amp.	Volt.
11:05	—	1.6	11:08	—	1.9
11:06	4	.7	11:09	4	1.7
11:07	3	.5	11:11	4	1.6
			11:12	4	1.5
			11:13	4	1.5
			11:14	4	1.4
			11:15	4	1.4
			11:16	4	1.3
			11:17	4	1.3
			11:18	4	1.2
			11:19	4	1.1
			11:20	4	1.0x
				12 Min.	

Second discharge without recharging on Cells 6 and 7 after standing 1 hr. 30 min.

CELL NO. 6 DEAD	CELL NO. 7 Time	Amp.	Volt.
	1:53	4	1.5
	1:54	4	1.4
	1:55	4	1.4
	1:56	4	1.3
	1:57	4	1.3
	1:58	4	1.2
	1:59	4	1.1
	2:00	4	1.0x
		7 Min.	

SEPTEMBER 26, 1952.

Discharge of Cells 6 and 7

Cells 6 and 7 put on charge at 10:55 at 7 amps. and charged for 1 hr. They were previously discharged on September 24, 1952.

CELL NO. 6		
Open Circuit Volt. 1.8		
Time	Amp.	Volt.
4:02	5	1.7
4:03		1.6
4:04		1.4
4:05		1.3
4:06		1.1
4:06½		1.0
	4¼ min.	

CELL NO. 7		
Open Circuit Volt. 1.9		
Time	Amp.	Volt.
4:08	5	1.9
4:10		1.9
4:15		1.8
4:30		1.7
4:35		1.7
4:40		1.7
4:45		1.7
4:50		1.6
4:55		1.5
4:56		1.4
4:57		1.4
4:58		1.4
4:59		1.3
5:00		1.2
5:01		1.1
5:02		1.1
5:03¾		1.0
	55¼ min.	

NOTE: Cells 6 and 7 stood from 5:21 p. m. on 9/23/52 till 2:40 on 9/26/52 when they were put on charge at 7 amp. till 3:40 p. m.

SEPTEMBER 24, 1952.

EFFECT OF AD–X2 ON GRAVITY

An Autolite high level group one cell required 550 cc. of liquid to bring level to a height such as to cover plates and plate lugs.

When 1 envelope of AD–X2 was added to 550 cc. of 1135 acid, the gravity rose to 1155.

SEPTEMBER 25, 1952.

To 550 cc. of 1300 acid in a graduate 1 envelope of AD–X2 was added. Acid was at approximately room temperature. Gravity rose to 1320.

Tests on New "Beacon" 13 Plate 90 A. H. Battery From Fresh Stock Made by Gould National

Cell No.	8	9	10
Sp. Gr.	1250	1250	1250
Temp.	22	22	22

Battery put on charge at 4 amp. at 10:50. AD–X2 added to Cell 10 at 10:55. Immediately after adding AD–X2, hydrometer reading was 1260. Note less gravity rise than when no elements are present.

After charging for 3 hrs. 17 min. whole battery was discharged starting at 2:07 at rate of 25 amp. At 5 P. M. battery would no longer light a single 21 C. P. bulb.

SEPTEMBER 26, 1952.

Visual inspection of plates in Cells 4, 5, 6, 7 at end of experiments showed negatives softer on treated cells than on untreated, even though hard sulphation had not been completely cleaned up.

SEPTEMBER 26, 1952.

Discharge on Cells 8, 9, 10 After Complete Discharge on September 25, 1952 and Standing Over Night

CELL NO. 9

Open Circuit Volt. 2.0

Time	Amp.	Volt.
11:30	10	1.9
11:31		1.9
11:32		1.9
11:33		1.9
11:34		1.9
11:35		1.9
11:36		1.9
11:37		1.9
11:38		1.9
11:39		1.8
11:40		1.8
11:41		1.8
11:42		1.7
11:43		1.7
11:44		1.7
11:45		1.7
11:46		1.6
11:47		1.4
11:47¾		.8

17¾ Min.

CELL NO. 10

Open Circuit Volt. 2.0

Time	Amp.	Volt.
11:50	10	1.8
11:52		1.8
11:53		1.8
11:54		1.8
11:55		1.8
11:56		1.8
11:57		1.8
11:58		1.8
11:59		1.8
12:00		1.8
12:01		1.8
12:02		1.8
12:03		1.8
12:04		1.8
12:05		1.7
12:06		1.6
12:07		1.4
12:07¾		.9

17¾ Min.

CELL NO. 8

Open Circuit Volt. 1.6

Time	Amp.	Volt.

Would not take 10 amp. load. Shorted.

NOTE that this battery, although fresh and charged starting at 1250 gr. for 3 hr. 17 min. at 4 amp. went only 2 hr. 53 min. at 25 amp. discharge indicating a defect.

OCTOBER 14, 1952.

Cells 11, 12, 13, and 14

These were four of six cells in a 12 V US2HM–11 Plate Willard airplane battery (probably 40 A. H.) obtained from salvage at Fort Devens. One end cell was removed for examination. It showed some sulphation and generally was in good condition. Cell between first two and fourth and fifth left empty and bridged for isolation purposes.

First two and fourth and fifth cells filled with 1100 acid.

Battery placed on charge for 10 minutes at 5 amps. After 10 minutes all cells showed 1.8 V open circuit. Cells immediately discharged.

Discharge Data

CELL NO. 11

Time	Amp.	Volt.
4:03	10	1.7
4:04		1.7
4:05		1.6
4:06		1.5
4:07		1.4
4:07:5		1.3
4:07:08		1.0

4 min., 8 sec.

CELL NO. 12

Time	Amp.	Volt.
4:09	10	1.7
4:10		1.6
4:11		1.6
4:12		1.6
4:13		1.55
4:14		1.5
4:15		1.5
4:16		1.2
4:16:30		1.0

7 min. 30 sec.

CELL NO. 13

Time	Amp.	Volt.
5:17	10	1.65
5:18		1.65
5:19		1.60
5:20		1.55
5:21		1.50
5:22		1.50
5:23		1.4
5:24		1.0

7 minutes

CELL NO. 14

Time	Amp.	Volt.
4:25	10	1.60
4:26		1.60
4:27		1.55
4:28		1.50
4:29		1.50
4:30		1.50
4:31		1.4
4:32		1.0

7 minutes

OCTOBER 15, 1952.

Cells 11 and 12 treated with AD–X2. Battery put on charge at 5 amp. from 4:40 to 5:35 and all cells discharged to 1 amp. on short circuit. Battery allowed to stand in discharged condition till October 20.

No gravities or temperatures taken since charge period was too short to affect them.

OCTOBER 20, 1952.

Cells 11, 12, 13, and 14

Discharge After Recovery From October 15 to October 20

CELL NO. 11

Time	Amp.	Volt.
2:30	5	1.65
2:31	5	1.65
2:32	5	1.65
2:33	5	1.65
2:34	5	1.60
2:35	10	1.60
2:36		1.60
2:37		1.60
2:38		1.60
2:39		1.60
2:40		1.55
2:41		1.55
2:44		1.55
2:45		1.50
2:47		1.50
2:48		1.45
2:49		1.35
2:50		1.2
2:51		1.1
2:51:15		1.0

21 min. 15 sec.

CELL NO. 13

Time	Amp.	Volt.
3:09	5	1.8
3:10	5	1.7
3:11	5	1.7
3:12	5	1.7
3:13	5	1.7
3:15	10	1.7
3:20		1.7
3:22		1.7
3:24		1.65
3:26		1.6
3:27		1.6
3:28		1.5
3:29		1.2
3:29:30		1.0

20 min. 30 sec.

CELL NO. 12

Time	Amp.	Volt.
3:31	5	1.8
3:32	5	1.8
3:33	5	1.8
3:34	5	1.8
3:35	5	1.8
3:36	10	1.75
3:38		1.75
3:40		1.75
3:42		1.75
3:44		1.75
3:46		1.75
3:48		1.75
3:50		1.70
3:51		1.65
3:53		1.65
3:54		1.60
3:55		1.55
3:56		1.5
3:57		1.3
3:58		1.2
3:58:45		1.0

27 min. 45 sec.

CELL NO. 14

Time	Amp.	Volt
4:01	5	1.8
4:02	5	1.75
4:03	5	1.75
4:04	5	1.75
4:05	5	1.75
4:06	10	1.7
4:08		1.7
4:10		1.7
4:12		1.7
4:14		1.7
4:16		1.7
4:18		1.65
4:19		1.6
4:20		1.5
4:20:45		1.0

19 min. 45 sec.

OCTOBER 20, 1952.

Cells 11, 12, 13, and 14

Second Discharge After Standing From Times Given on Page 2—No Recharging

CELL NO. 11

Time	Amp.	Volt.
4:24	5	1.75
4:25		1.70
4:26		1.70
4:27		1.70
4:28		1.70
4:29		1.70
4:30		1.70
4:31		1.70
4:32		1.70
4:33		1.65
4:34		1.65
4:35		1.60
4:36		1.60
4:37		1.60
4:38		1.60
4:39		1.60
4:40		1.60
4:41		1.60
4:42		1.60
4:43		1.50
4:44		1.50
4:45		1.40
4:46		1.30
4:47		1.20
4:48		1.0

24 minutes

CELL NO. 13

Time	Amp.	Volt.
4:49	5	1.8
4:50		1.8
4:51		1.75
4:52		1.75
4:53		1.75
4:54		1.75
4:55		1.75
4:56		1.75
4:57		1.65
4:58		1.65
4:59		1.65
5:00		1.65
5:01		1.65
5:02		1.65
5:03		1.65
5:04		1.65
5:05		1.55
5:06		1.3
5:06:48		1.0

17 min. 48 sec.

CELL NO. 12

Time	Amp.	Volt.
5:08	5	1.85
5:09		1.76
5:10		1.75
5:11		1.75
5:12		1.75
5:13		1.75
5:14		1.75
5:15		1.75
5:16		1.75
5:17		1.75
5:18		1.75
5:19		1.75
5:20		1.7
5:21		1.7
5:22		1.7
5:23		1.7
5:24		1.7
5:25		1.7
5:26		1.65
5:27		1.65
5:28		1.60
5:29		1.55
5:30		1.5
5:31		1.4
5:32		1.3
5:33		1.25
5:34		1.20
5:34:45		1.0

26 min. 45 sec.

CELL NO. 14

Time	Amp.	Volt.
5:39	5	1.8
5:40		1.8
5:41		1.8
5:42		1.75
5:43		1.75
5:45		1.75
5:46		1.75
5:47		1.75
5:48		1.75
5:49		1.75
5:50		1.75
5:51		1.75
5:52		1.75
5:53		1.75
5:54		1.70
5:55		1.70
5:56		1.70
5:57		1.70
5:58		1.65
5:59		1.65
6:00		1.60
6:01		1.55
6:02		1.2
6:02:48		1.0

23 min. 48 sec.

OCTOBER 21, 1952.

Cells 15 and 16

These were two cells from a standard automobile battery supposed sulphated. Third cell was removed, plates were in good condition and showed sulphation. Battery was a Mobile Delux 51 plate 120 A. H. Group II. Cells charged at 5 amp. for 15 min.

Discharge Data

CELL NO. 15

Time	Amp.	Volt.
4:32	5	1.7
4:33		1.7
4:34		1.7
4:35		1.7
4:36		1.7
4:37		1.7
4:38		1.6
4:39		1.6
4:39:30		1.0

7 min. 30 sec.

CELL NO. 16

Time	Amp.	Volt.
5:42	5	1.7
5:43		1.7
5:44		1.7
5:45		1.7
5:46		1.6
5:47		1.6
5:48		1.6
5:49		1.6
5:50		1.5
5:50:15		1.0

8 min. 15 sec.

OPEN CIRCUIT VOLTAGE

Cell 15 1.8
Cell 16 1.8

OCTOBER 22, 1952.

Cells put on charge at 2:41 at 5 amps. AD–X2 added to Cell 15 at 2:48. Cells taken off charge at 3:45.

Discharge Data

CELL NO. 15

Time	Amp.	Volt.
4:00	15	1.75
4:01		1.80
4:02		1.75
4:03		1.75
4:04		1.75
4:05		1.75
4:06		1.75
4:07		1.75
4:08		1.7
4:09		1.6
4:09:30		1.0

9 min. 30 sec.

CELL NO. 16

Time	Amp.	Volt.
4:11	15	1.80
4:12		1.75
4:13		1.75
4:14		1.75
4:15		1.75
4:16		1.75
4:17		1.75
4:18		1.75
4:19		1.75
4:20		1.7
4:21		1.6
4:21:20		1.0

10 min. 20 sec.

OPEN CIRCUIT VOLTAGE

Cell 15 1.95
Cell 16 1.90

OCTOBER 23, 1952.

Cells 15 and 16

Cells recharged at 5½ Amps. from 8:45 to 11:45.

Discharge Data

CELL NO. 15

Time	Amp.	Volt.
2:44	51	1.7
2:45	51.6	1.75
2:46	52.5	1.75
2:47	52.7	1.80
2:48	52.5	1.75
2:49	52.5	1.70
2:50	52.5	1.70
2:51	51.6	1.65
2:52	51.2	1.60
2:53	49.4	1.50
2:54	45.7	1.45
2:55	36.2	1.0

11 min.

CELL NO. 16

Time	Amp.	Volt.
2:53	54	1.7
2:54	54	1.7
2:55	54	1.7
2:56	54	1.7
2:57	53.2	1.65
2:58	53.2	1.65
2:59	52.5	1.65
3:00	51.2	1.6
3:01	51	1.55
3:02	48.7	1.50
3:03	41.9	1.2
3:03:30	34.4	1.0

10 min. 30 sec.

OPEN CIRCUIT VOLT.

Cell 15 1.95
Cell 16 1.95

Variable discharge rate because of difficulty with rheostat

OCTOBER 23, 1952.

Cells 15 and 16

These cells placed on charge at 4:15 at 5 amps.

OCTOBER 24, 1952.

Cells 15 and 16

Off charge at 2:45. However, these cells did not charge overnight. Clip fell off during night.

Gravity Reading

Cell No.	15	16
Gravity	11. 50	11. 50

These cells placed on charge again at 9:10 and taken off at 6:25.

OCTOBER 28, 1952.

Cells 15 and 16

CELL NO. 15			CELL NO. 16		
Time	Amp.	Volt.	Time	Amp.	Volt.
3:48	40	1. 75	3:00	40	1. 75
3:56		1. 75	3:01		1. 75
4:00		1. 75	3:02		1. 75
4:10		1. 75	3:06		1. 75
4:12		1. 70	3:10		1. 75
4:15		1. 70	3:15		1. 75
4:20		1. 70	3:20		1. 75
4:25		1. 65	3:25		1. 75
4:30		1. 60	3:27		1. 65
4:32		1. 50	3:30		1. 65
4:33		1. 40	3:35		1. 65
4:33:30		1. 2	3:40		1. 65
4:35		1. 0	3:42		1. 55
47 min.			3:44		1. 50
			3:45		1. 40
			3:45:15		1. 30
			3:45:30		1. 10
			3:45:50		1. 00
			45 min. 50 sec.		

NOTE: Cell 16 was discharged before Cell 15 as recorded.

OCTOBER 30, 1952.

Cells 15 and 16 placed on charge at 4 amp. at 11:25.
Cells 15 and 16 taken off charge at 2:40.

OCTOBER 31, 1952.

Discharge Data—Cells 15 and 16

CELL NO. 15			CELL NO. 16		
Time	Amp.	Volt.	Time	Amp.	Volt.
12:50	40	1. 55	1:15	40	1. 75
12:51		1. 55	1:17		1. 75
12:53		1. 55	1:18		1. 75
12:54		1. 55	1:20		1. 75
12:55		1. 55	1:25		1. 75
12:57		1. 55	1:27		1. 70
1:00		1. 55	1:31		1. 65
1:02		1. 50	1:32		1. 65
1:04		1. 50	1:35		1. 60
1:05		1. 50	1:37		1. 50
1:07		1. 45	1:38		1. 40
1.10		1. 35	1:39		1. 20
1:11		1. 00	1:39:10		1. 00
21 min.			24 min. 10 sec.		

OCTOBER 23, 1952.

Cells 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, and 28

These are two type U. S. 2HN–11 Plate airplane batteries made by Willard and obtained from salvage from Fort Devens at same time as were Cells 11–12–13–14. All cells dry as received—filled with 1100 acid. All cells placed on charge at 5 amps. at 2:27.

Discharge Data

CELL NO. 17

Time	Amp.	Volt.
3:36	30	1.75
3:37	30	1.75
3:37:30	18	1.0

CELL NO. 19

Time	Amp.	Volt.
3:44	30	1.65
3:45	30	1.65
3:46	30	1.55
3:47	29	1.5
3:48	23	1.1
3:48:20	18	1.10

CELL NO. 21

Time	Amp.	Volt.
3:52	30	1.3
3:53	30	1.1
3:53:10	30	1.0

OPEN CIRCUIT VOLT.

Cell	Volt.
17	2
18	1.9
19	2
20	1.9
21	1.8
22	1.8
23	1.9
24	1.6
25	0.3
26	1.45
27	0.05
28	1.3

CELL NO. 18

Time	Amp.	Volt.
3:38	30	1.6
3:39	29	1.5
3:40	29	1.5
3:41	28	1.5
3:42	25	1.3
3:42:30	23	1.0

CELL NO. 20

Time	Amp.	Volt.
3:49	30	1.6
3:49:45	24	1.0

CELL NO. 22

Time	Amp.	Volt.
3:55	30	1.4
3:55:45	29	1.0

OCTOBER 23, 1952.

Cells Nos. 17–18–19–20–21–22–23–24–25–26–27–28

CELL NO. 23

Time	Amp.	Volt.
3:58	30	1.4
3:59	30	1.1
3:59:15	30	1.0

CELL 24	DEAD
CELL 25	DEAD
CELL 26	DEAD
CELL 27	DEAD
CELL 28	DEAD

Following cells treated with AD–X2:

Cells Nos. 20–22–24–26–28

All cells placed on charge at 4 amps. at 4:15 p. m. All gravities at close of charge under 1100—float just about floats.

OCTOBER 24, 1952.

Cells Nos. 17–18–19–20–21–22–23–24–25–26

Taken off charge at 10:10. Impossible to get reading of temperatures during charging because could not get thermometer bulb immersed through filler hole.

Gravity Readings at 2:30

CELL NO.	17	18	19	20	21	22	23	24	25	26	27	28
Gravity	1160	1140	1175	1220	1145	1175	1200	1235	1200	1225	1200	1200

OCTOBER 24, 1952.

Cells 17 to 28

Discharge Data

CELL NO. 17

Time	Amp.	Volt.
3:11	30	1.7
3:12		1.7
3:15		1.7
3:17		1.7
3:19		1.7
3:20		1.7
3:25		1.65
3:29		1.5
3:29:45		1.0

18 min. 45 sec.

CELL NO. 18

Time	Amp.	Volt.
3:31	30	1.75
3:32		1.75
3:35		1.75
3:39		1.75
3:40		1.75
3:45		1.75

Terminal Broke

CELL NO. 19

Time	Amp.	Volt.
4:10	30	1.85
4:15		1.85
4:20		1.85
4:22		1.85
4:25		1.80
4:30		1.80
4:32		1.80
4:35		1.80
4:40		1.75
4:45		1.65
4:46		1.60
4:47:30		1.0

37 min. 30 sec.

CELL NO. 20

Time	Amp.	Volt.
4:51	30	1.9
4:55		1.85
5:00		1.85
5:05		1.75
5:10		1.70
5:12		1.60
5:13		1.30
5:14:45		1.00

23 min. 45 sec.

CELL NO. 21

Time	Amp.	Volt.
5:16	30	1.8
5:17		1.8
5:19		1.8
5:25		1.8
5:30		1.8
5:35		1.75
5:36		1.70
5:38		1.70
5:40		1.65
5:42		1.65
5:44		1.60
5:45		1.40
5:45:30		1.0

29 min. 30 sec.

CELL NO. 22

Time	Amp.	Volt.
5:47	30	1.85
5:49		1.80
5:55		1.75
5:00		1.75
6:05		1.70
6:10		1.70
6:15		1.60
6:17		1.5
6:18		1.4
6:20		1.0

33 min

OCTOBER 27, 1952.

Cells 23 to 28

Discharge After Standing Since October 24 at 2:30

CELL NO. 23

Time	Amp.	Volt.
3:34	40	1.8
3:35		1.8
3:40		1.8
3:45		1.75
3:47		1.70
3:50		1.65
3:53		1.60
3:55		1.60
3:56		1.55
3:58		1.50
3:59		1.40
3:59:15		1.20
3:59:30		1.00

25 min. 30 sec.

CELL NO. 24

Time	Amp.	Volt.
4:01	40	1.8
4:05		1.8
4:10		1.8
4:13		1.75
4:15		1.75
4:17		1.70
4:19		1.65
4:20		1.60
4:21		1.50
4:22		1.20
4:22:15		1.00

21 min. 15 sec.

CELL NO. 25

Time	Amp.	Volt.
4:30	40	1.8
4:32		1.8
4:35		1.8
3:40		1.75
3:41		1.70
3:44		1.60
3:45		1.50
3:45:15		1.40
3:45:30		1.30
3:45:45		1.20
3:46		1.00

16 min.

OPEN CIRCUIT VOLT.

Cell	Volt.
23	2.0
24	2.0
25	2.0
26	2.1
27	2.0
28	2.1

CELL NO. 26

Time	Amp.	Volt.
11:29	40	1.8
11:30		1.85
11:35		1.80
11:36		1.75
11:40		1.75
11:44		1.65
11:45		1.60
11:46		1.55
11:46:30		1.50
11:47		1.40
11:47:30		1.30
11:48		1.1
11:48:15		1.0

19 min. 15 sec.

CELL NO. 27

Time	Amp.	Volt.
1:30	40	1.75
1:34		1.65
1:35		1.65
1:40		1.60
1:42		1.50
1:43		1.40
1:43:30		1.30
1:43:45		1.20
1:44:20		1.00

14 min. 20 sec.

CELL NO. 28

Time	Amp.	Volt.
1:46	40	1.85
1:50		1.85
1:55		1.75
1:58		1.70
2:00		1.70
2:02		1.65
2:05		1.60
2:07		1.55
2:10		1.50
2:11		1.40
2:12		1.20
2:12:15		1.10
2:12:30		1.00

26 min. 30 sec.

NOTE.—Then these cells discharged about eighteen hours after Cells 23, 24, 25.

NOTE.—Sulphated cells probably do not hold charge till after sulphate is completely broken.

OCTOBER 27, 1952.

Cells 29 and 30

These are two cells from a Willard heavy duty 115 AH 6-volt automobile battery, group 2, 17 plates per cell. Third cell cracked. This battery obtained from Mr. Goodwin. Battery had stood with electrolyte in it for 2½ years. Charged from 3:16 to 4:41 at 5 amps. Cell 30 treated with AD–X2.

OCTOBER 28, 1952.

Cells 29 and 30

CELL NO. 29			CELL NO. 30		
Time	Amp.	Volt.	Time	Amp.	Volt.
2:36	60		2:38:15	75	1.7
Died immediately			2:38:45		1.1

OCTOBER 30, 1952.

Discharge Data, Cells 29 and 30

Cells 29 and 30 on charge at 6 amps. 2:45 P. M. taken off 5:55.

CELL NO. 29			CELL NO. 30		
Time	Amp.	Volt.	Time	Amp.	Volt.
11:42	10	1.65	2:07	10	1.70
11:43		1.65	2:08		1.70
11:50		1.65	2:10		1.70
11:55		1.60	2:15		1.70
12:00		1.55	2:20		1.70
12:10		1.55	2:25		1.70
12:15		1.55	2:30		1.70
12:20		1.55	2:35		1.70
12:25		1.50	2:40		1.70
12:26		1.40	2:45		1.65
12:27		1.20	2:50		1.65
12:28:30		1.10	2:55		1.65
12:28		1.00	3:00		1.65
46 min. 30 sec.			3:05		1.65
			3:07		1.60
			3:10		1.60
			3:12		1.55
			3:15		1.55
			3:19		1.50
			3:20		1.40
			3:22:15		1.15
			3:22		1.00
			75 min. 15 sec.		

OCTOBER 27, 1952.

Cells Nos. 31, 32, 33, 34

These cells from Exide radio battery brought to Boston by Ritchie on October 27. Cells were dry—elements only brought—no case. Battery was dated on strap sixth month of 1942. These four cells made from two larger cells. In this process one positive from each of the larger cells was discarded.

Cells were placed in distilled water and assembled into a plastic airplane case made for six cells. Two center compartments were left empty for insulation. New separators were installed in all cells. Then cells put on charge at 4.5 amps at 2:43 and taken off at 4:50.

Cells 31 and 32 treated with AD–X2.

Voltages

CELLS	31	32	33	34
Immediately after treatment	4.4	4.4	4.1	4.1
Five minutes after treatment	2.9	2.9	4.8	4.7
At 2:54	3.1	3.1	3.8	3.8
At 3:21	2.9	2.9	2.8	2.7

Thermometers were inserted in all cells. Thermometers were checked for agreement before using.

Treated cells during charge ran about 2° C. cooler than untreated cells (28° versus 30°). After charge had stopped treated cells rose 1° to 2° above untreated cells. Treated cells showed heavier and more lasting froth than untreated cells.

OCTOBER 28, 1952.

Voltages, Open Circuit

CELL	31	32	33	34
Voltage	1.20	1.20	1.45	1.40
Temp.	24	24	25	25

On Charge at 5 amp. at 2:20.

CELL	31	32	33	34
Voltage	2.90	2.90	4.25	4.00

OCTOBER 28, 1952.

Cells 31, 32, 33, 34

Charging

CELL	31	32	33	34
Voltage	3.0	3.0	3.8	3.40
Time	2:25	2:25	2:25	2:25
Temperature	25	24	27	26
Time	2:32	2:32	2:32	2:32
Temperature	26	25	28	28
Voltage	2.80	2.80	2.90	2.85
Time	2:45	2:45	2:46	2:46
Temperature	28	27	30	30
Voltage	2.60	2.60	2.80	2.80

At 2:55 treated cells were evolving large amounts of fine pin point bubbles. Untreated cells were evolving larger bubbles.

CELL	31	32	33	34
Time	3:22	3:22	3:23	3:23
Temperature	32	31	31	30
Voltage	2.40	2.40	2.60	2.60

Above temperatures may have been influenced by presence of light to observe fine bubble formation.

Charging—Continued

CELL	31	32	33	34
Time	4:57	4:57	4:58	4:58
Temperature	35	34	34	34
Voltage	2. 40	2. 40	2. 35	2. 35

Cells taken off charge 5:00.

OCTOBER 28, 1952.

Cells 31, 32, 33, and 34

Discharge Data

CELL NO. 31

Time	Amp.	Volt.
5:05	10	1.7
5:07	10	1.65
5:09	10	1.60
5:10	10	1.55
5:11	10	1.55
5:12	10	1.50
5:13	10	1.50
5:14	10	1.40
5:15	10	1.40
5:17	10	1.40
5:18	10	1.30
5:19	10	1.20
5:19	10	1.10
5:19	10	1.10

14 min. 50 sec.

CELL NO. 33

Time	Amp.	Volt.
5:22	10	1.6
5:23	10	1.55
5:24	10	1.50
5:25	10	1.50
5:26	10	1.50
5:28	10	1.40
5:28	10	1.10
5:28	10	1.10

6 min. 35 sec.

OPEN CIRCUIT VOLTAGE

Cell #31 Volt. 1.8

Cell #32 Volt.

Cell #33 Volt.

Cell #34 Volt.

CELL NO. 32

Time	Amp.	Volt.
5:33	10	1.65
5:34	10	1.60
5:35	10	1.60
5:36	10	1.55
5:37	10	1.55
5:38	10	1.50
5:39	10	1.50
5:40	10	1.50
5:41	10	1.50
5:42	10	1.50
5:43	10	1.45
5:43	10	1.40
5:44	10	1.35
5:45	10	1.30
5:46	10	1.10
5:46	10	1.00

13 min. 45 sec.

CELL NO. 34

Time	Amp.	Volt.
5:48	10	1.55
5:49	10	1.55
5:50	10	1.50
5:51	10	1.50
5:52	10	1.4
5:53	10	1.4
5:53	10	1.1
5:54		1.0

6 min. 1 sec.

OCTOBER 30, 1952.

Cells 31, 32, 33, and 34, although starting with equal liquid levels, required the following amounts of water to again make levels equal: Cell 31, none; Cell 32, none; Cell 33, 22 c. c.; Cell 34, 31 c. c.

OCTOBER 31, 1952.

Cells Nos. 31, 32, 33, 34

Each cell killed individually.

Water added to each cell to bring level to mark put on transparent case.

Hydrometer will not float in any cell.

On charge at 12:40 at 6 amp.

Cell No.	31	32	33	34	Time
Voltage	2.35	2.30	2.40	2.40	12:43
Voltage	2.21	2.21	2.19	2.19	1:16
Gravity	Float just floats		Float doesn't float		2:21
Temperature	30.8	30.8	31.6	32	2:50
Voltage	2.25	2.25	2.20	2.20	5:31
Gravity	Same as above				
Temperature	34	35	35	36	5:20

Above cells off charge at 5:40.

NOVEMBER 3, 1952.

Discharge on Cells Nos. 31, 32, 33, 34

CELL NO. 31			CELL NO. 33		
Time	Amp.	Volt.	Time	Amp.	Volt.
3:20	20	1.75	3:46	20	1.75
3:22		1.70	3:47		1.70
3:31		1.60	3:48		1.65
3:37		1.55	3:49		1.60
3:40		1.50	3:50		1.60
3:41		1.45	3:55		1.55
3:42		1.40	3:56		1.50
3:43		1.30	4:01		1.45
3:44		1.20	4:05		1.45
3:44:10		1.10	4:07		1.30
3:44:15		1.00	4:08		1.10
24 min. 15 sec.			4:08:10		1.00
			22 min. 10 sec.		

NOVEMBER 3, 1952.

Charge Data

Cell No.	31	32	33	34	Time	
Voltage	1.8	1.8	1.8	1.8	9:25	Open circuit.
Voltage	2.25	2.25	2.20	2.20	9:38	On charge at 5 amp.
Voltage	2.30	2.30	2.26	2.26	11:27	On charge.
Voltage	2.30	2.31	2.26	2.24	12:55	On charge.

Suntester Voltmeter checked against Hoyt voltmeter:

	Sun meter 2.30		Hoyt meter 2.25			
Gravity	1100	1100	Less than 1100			
Voltage	2.28	2.29	2.26	2.25	2:10	
Temperature	33	33	34	34	2:30	Off charge.

NOVEMBER 3, 1952.

Discharge Data

CELL NO. 32			CELL NO. 34		
Time	Amp.	Volt.	Time	Amp.	Volt.
4:10	20	1.70	4:34	20	1.75
4:10		1.70	4:36		1.70
4:13		1.65	4:40		1.70
4:16		1.65	4:45		1.65
4:20		1.60	4:46		1.60
4:25		1.60	4:48		1.60
4:28		1.55	4:50		1.55
4:30		1.50	4:51		1.50
4:31		1.45	4:52		1.40
4:31:30		1.30	4:52:15		1.80
4:32		1.20	4:52:25		1.20
4:32:30		1.10	4:52:30		1.1
4:32:45		1.00	4:52:40		1.0
22 min. 45 sec.			18 min. 40 sec.		

OPEN CIRCUIT VOLTAGE

Cell 31 Voltage 2.1
Cell 32 Voltage 2.0
Cell 34 Voltage 2.0

NOTE: Above cells have received considerable charging and since they are probably about 30 amp. hour units probably have recovered to a considerable degree. Also note gravity cannot be expected to rise very high even on full charge since cells were at start filled with distilled water, and moreover, cells contain much free volume for excess liquid, thus tending to result in a low gravity.

NOVEMBER 4, 1952.

Discharge After Standing All Night and After Discharge

CELL NO. 31			CELL NO. 33		
Time	Amp.	Volt.	Time	Amp.	Volt.
11:36	5	1.8	4:24:30	5	1.8
11:38		1.75	4:37		1.75
12:05		1.70	4:50		1.70
12:15		1.65	4:57		1.65
12:30		1.60	5:06		1.65
12:44		1.5	5:24		1.55
12:47		1.4	5:34		1.50
12:49		1.25	5:38		1.4
12:50		1.2	5:39		1.3
12:52		1.1	5:41		1.1
12:53		1.05	5:43		1.0
12:53:30		1.			
77 min. 30 sec.			78 min 30 sec.		

OCTOBER 29, 1952.

Cells 35, 36, 37, 38, 39, and 40

These are Sunoco type 112E acquired October 29th.
Cells 35, 36, 37, strap dated November 1947.
Cells 38, 39, 40, strap dated February 1948.
Cells contained residue of original electrolyte.
Liquid level adjusted by adding distilled water.
All six cells on charge at 5 amp. at 1:55 P. M.—off at 2:55.
New separators were installed in all cells.

Discharge after 1 hour charge at 5 amp.

CELL 35	CELL 36	CELL 37			CELL 38	CELL 39	CELL 40
Dead	Dead	Time	Amp.	Volt.	Dead	Dead	Dead
		4:25	3.75	1.4			
		4:27	3.75	1.2			
		4:28	3.75	1.1			
		4:29:30		1.0			
		4 min. 30 sec.					

After discharge cells 36, 38, 40 were treated with AD–X2. Note that apparent best cell #37 was not treated.

All six cells on charge at 4:55 P. M. at 5 amp.

Voltage readings on charge at 5 amp.

	CELL 35	CELL 36	CELL 37	CELL 38	CELL 39	CELL 40
Time			VOLTAGES			
5:25	2.80	2.60	2.20	2.55	2.35	2.45
5:43	2.50	2.35	2.05	2.45	2.30	2.40
6:00	2.50	2.28	2.01	2.30	2.20	2.21

Off charge at 6:00 P. M.

October 30, 1952.

At 10:30 checked cells 35, 36, 37, and 38, 39, 40 for shorts between cells with 110 volt test lamp. Cells 35 and 36 are shorted. On ohmmeter resistance is under 60 ohm. Resistance between 36 and 37 is under 2000 ohm. Others show several thousand ohms between cells and no glow on test lamp.

Cells 37, 38, 39, 40 on charge at 11:25 at 4 amp.

October 31, 1952.

Discharge on Cells 37, 38, 39, and 40

CELL NO. 37			
Time	Amp.	Volt.	
1:45	40	1.55	
1:46		1.55	Cells 38, 39, 40 were dead in spite of fact that they were charged in series with Cell 37.
1:47		1.50	
1:48		1.45	
1:49		1.35	
1:50		1.20	
1:50:30		1.00	
5 min. 30 sec.			

October 30, 1952.

Cells 41, 42, 43, 44, 45, 46

These were put on charge at 11:45.

These are two cell batteries made by removing center cell from Sunoco 112E type batteries obtained by Goodwin and Ritchie on October 29th. These cells filled with enough distilled water to bring level up. Cells 41 and 42 have original separators. Cells 43, 44, 45, 46 have original wood separators. Cells off charge at 12:15.

OCTOBER 31, 1952.

Cells 41 through 56 put on charge (with 6 unnumbered cells for Dr. Beattie) at 2:45. Can get less than 1 amp. through bank. Off charge at 3:45. Every cell was dead. At 4:05 following cells were treated 42, 47, 55, 53, 52, and put on charge at 5 amp. Off charge at 5:30.

Reading	Cell	41	42	43	44	45	46	47	48	49	50
TAKEN	Temp. °C.	38°	33°	—	—	—	—	32	36	—	—
5:10 to	Gravity	NR	NR	—	—	—	—	NR	NR	—	—
5:15	Volt.*	2.90	2.60	—	—	—	—	2.60	2.90	—	—

* Voltages with 6 amp. charging current.

Cell	51	52	53	54	55	56
Temp. °C.	28°	29°	27	32	34	35
Gravity	NR	NR	NR	NR	NR	NR
Voltage*	2.20	2.35	2.10	3.00	3.00	2.90

*Voltages with 6 amp. charging current.
*Approximately.
— Not on charge.
NR Too low to read.

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Cells 41–42, 47–48, 51–52, 53–54, 55–56

These cells previously on charge at 5 amp. for 1 hour 25 minutes. Again placed on charge at 2 amp. at 9:15. Charge rate up to 4.5 amp. at 9:30.

CELL	41	42	47	48	51	52	53	54	55	56	Time
On Charge Volt.	4.01	3.02	2.90	3.78	2.30	2.52	2.05	3.50	3.48	3.52	9:15
On Charge Volt.	2.32	2.25	2.20	2.40	2.20	2.30	2.18	2.40	2.41	2.39	12:55

Discharge

CELL NO. 47

Time	Amp.	Volt.
1:00	40	1.2
1:00		1.0

CELL NO. 48

Time	Amp.	Volt.
Not up to 40 amp. Dead		

CELL NO. 41

Time	Amp.	Volt.
Not up to 40 amp. Dead		

CELL NO. 42

Time	Amp.	Volt.
Not up to 40 amp. Dead		

CELL 51

Time	Amp.	Volt.
1:05	10	1.60
1:07		1.60
1:09		1.60
1:10		1.55
1:12		1.50
1:14		1.40
1:15		1.30
1:16		1.10
1:16:30		1.00

11 min. 30 sec.

CELL 52

Time	Amp.	Volt.
1:20	10	1.65
1:21		1.65
1:22		1.60
1:23		1.55
1:24		1.50
1:25		1.45
1:26		1.40
1:28		1.10
1:28:45		1.00

8 min. 45 sec.

CELL 55

Time	Amp.	Volt.
1:30	10	1.65
1:31		1.50
1:31:15		1.40
1:31:30		1.30
1:32		1.10
1:32:05		1.00

2 min. 5 sec.

CELL 56

Time	Amp.	Volt.
1:35:30	10	1.50
1:36:30		1.00

1 min.

Sulphate on Cell 52 soft.
Sulphate on Cell 51 hard.

Cells 41, 42, 47, 48, back on charge at 5 amp. at 1:30.

Discharge

CELL NO. 53			CELL NO. 54		
Time	Amp.	Volt.	Time	Amp.	Volt.
1:45	10	1.65	2:18	10	1.10
1:46		1.65	2:18:30		1.00
1:48		1.65	30 sec.		
1:50		1.65			
1:55		1.65			
2:00		1.60	Sulphate on Cell		
2:04		1.55	No. 53 soft.		
2:05		1.50	Sulphate on Cell		
2:07		1.50	No. 54 hard.		
2:10		1.40			
2:11		1.35			
2:12		1.25			
2:13		1.26			
2:14		1.15			
2:15		1.05			
2:15:30					
30 min. 30 sec.					

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Cells 44, 45, 50 treated at 3:30.

Cells 41–42, 43–44, 45–46, 49–50, 51–52, 53–54, 55–56.

Also 101A, 101B, 102A, 102B, 103A, 103B for Dr. Beattie placed on charge at 3:40.

NOVEMBER 4, 1952.

Discharge

CELL NO. 53			CELL NO. 54			CELL NO. 41	CELL NO. 42
Time	Amp.	Volt.	Time	Amp.	Volt.	Dead. "Sulphated out."	Not run because it was dead.
2:30	20	1.75	2:57		1.15		
2:32		1.65	2:58:40		1.00		
2:35		1.65	1 min. 40 sec.				
2:40		1.60					
2:42		1.55					
2:44		1.55					
2:45		1.40					
2:46		1.30					
2:47		1.25					
2:48		1.10					
2:49		1.05					
2:49:50		1.00					
19 min. 50 sec.							

CELL NO. 55			CELL NO. 56			CELL NO. 53			CELL NO. 54		
Time	Amp.	Volt.	Time	Amp.	Volt.	Time	Amp.	Volt.	Time	Amp.	Volt.
3:20	20	1.10	3:23	20	1.10	3:24	20	1.50	3:30	20	1.2
3:20:10		1.00	3:23:20		1.00	3:25		1.50	3:30:30		1.0
10 sec.			20 sec.			3:26		1.40	30 sec.		
						3:27		1.30			
						3:28		1.20			
						3:28:55		1.00			
						4 min. 55 sec.					

Cells 41 and 42 discarded because 41 "sulphated out" on trying to charge it.

NOVEMBER 4, 1952.

Cells 45 and 46

Discharge Data

CELL NO. 45

Time	Amp.	Volt.
3:22	20	——
	Dead	

CELL NO. 46

Time	Amp.	Volt.
3:33	20	——
	Dead	

CELL NO. 49

Time	Amp.	Volt.
3:34	20	——
	Dead	

CELL NO. 50

Time	Amp.	Volt.
	Dead	

CELL NO. 43

Dead

CELL NO. 44

Dead

CELL NO. 51

Time	Amp.	Volt.
3:28	20	1.60
3:42		1.55
3:43		1.45
3:44		1.40
3:45		1.10
3:45:15		1.00
7 min. 15 sec.		

CELL NO. 52

Time	Amp.	Volt
3:47	20	1.50
3:48		1.50
3:50		1.40
3:51		1.30
3:52		1.10
3:52:15		1.00
5 min. 15 sec.		

CELL NO. 47

Time	Amp.	Volt.
4:07	20	1.65
4:10		1.60
4:11		1.60
4:13		1.55
4:14		1.50
4:15		1.40
4:16		1.40
4:17		1.20
4:18		1.20
4:19		1.05
4:20		1.00
13 min.		

CELL NO. 48

Time	Amp.	Volt.
4:22		
	Dead	

Cells 41–42, 43–44, 45–46, 49–50, 51–52, 53–54, 55–56, on charge at 4:10 at 3.6 amps. Cell 47–48 on charge at 4:30.

All these cells off charge at 9:30 AM November 5th.

NOVEMBER 5, 1952.

Plates on 52 considerably softer near edges than on any part of 51 after charging all night.

NOVEMBER 5, 1952.

Cells 53 and 54 show slightly irridescent film as if oil were present. These two cells may be contaminated.

Cell 52—Examined plates on this cell and found 4 cracked positives.

Cell 51 has no cracked positives.

Cells 45 and 46 off charge at 1:30.

Discharge Data

CELL NO. 45

Time	Amp.	Volt.
1:34	40	1.50
1:35		1.50
1:36		1.40
1:37		1.40
1:38		1.40
1:40		1.40
1:43		1.40
1:47		1.40
1:48		1.35
1:50		1.25
1:51		1.20
1:52		1.15
1:53		1.05
1:53:45		1.00

19 min. 45 sec.

CELL NO. 46

Time	Amp.	Volt.
1:55	40	1.35
1:56		1.35
1:57		1.30
1:58		1.25
1:59		1.20
2:00		1.15
2:01		1.15
2:02		1.10
2:03		1.05
2:04		1.00

9 min.

103A and 103B off charge at 2:05.
53–54 off charge at 2:30.
43–44 off charge at 2:30.

NOVEMBER 5, 1952.

Hydrometer Readings Taken at 10:30

CELL	49	50	45	46	53	54	47	48	
Gravity	1050	1100	1110	1050	1110	1050	1140	1050	
Water Make Up	38	72	20	54	20	66	*	*	CC

CELL	44	43	55	56	103A	103B		
Gravity	1105	1050	1080	1050	1050	1120		
Water Make Up	18	100	68	92	122	88		CC

Gravities less than 1100 taken with additional hydrometer. 1.000–1.500 checked against two battery hydrometers being used.

*Cannot do because no reference level found in cell (ledge on case).

Cells 49, 50, 45, 46, 53, 54, 44, 43, 55, 56, 103A, 103B put on charge again at 11:10 at 6 amp.

Discharge Data

CELL NO. 47

Time	Amp.	Volt.
11:17	40	1.60
11:20		1.60
11:22		1.60
11:27		1.55
11:30		1.50
11:35		1.50
11:37		1.45
11:38		1.40
11:39		1.35
11:40		1.35
11:42		1.30
11:43		1.20
11:44		1.10
11:45		1.00

28 Min.

CELL NO. 48

Time	Amp.	Volt.
11:50:30	40	1.45
12:01		1.40
12:02		1.30
12:03		1.25
12:04		1.10
12:04:30		1.10

5 Min.

CELL NO. 49

Time	Amp.	Volt.
1:03	40	1.60
1:07		1.55
1:08		1.50
1:10		1.40
1:11		1.35
1:12		1.15
1:12:10		1.00

7 Min. 10 Sec.

Discharge Data—Continued

CELL NO. 50

Time	Amp.	Volt.
1:13	40	1.60
1:15		1.55
1:16		1.55
1:17		1.55
1:18		1.50
1:19		1.50
1:20		1.45
1:21		1.45
1:22		1.40
1:23		1.30
1:24		1.20
1:24:45		1.00

11 Min. 45 Sec.

11:55 Visual examination of cells 49, 50, 45, 46, 53, 54, 44, 43, 55, 56, 103A, 103B while under charge at 6 amp. show treated cells evolving characteristic small bubbles in case of all treated cells (with exception noted) and surface appeared more viscous. Could not clearly see difference in case of cells 53 and 54.

NOVEMBER 5, 1952.

Discharge Data

CELL NO. 53

Time	Amp.	Volt.
3:32	40	1.60
3:35		1.55
3:40		1.55
3:45		1.55
3:50		1.50
3:55		1.45
4:00		1.40
4:05		1.35
4:06		1.30
4:07		1.25
4:09		1.20
4:10		1.20
4:12		1.00

40 min

CELL NO. 54

Time	Amp.	Volt.
4:14	40	1.60
4:15		1.50
4:18		1.50
4:20		1.40
4:21		1.30
4:22		1.20
4:22:25		1.00

8 min. 25 sec.

CELL NO. 43

Time	Amp.	Volt.
4:30	40	1.45
4:32		1.35
4:32:30		1.30
4:33		1.20
4:34		1.00

4 min.

CELL NO. 44

Time	Amp.	Volt.
4:34	40	1.60
4:36		1.50
4:40		1.50
4:43		1.40
4:45		1.30
4:45:30		1.20
4:46		1.10
4:46:30		1.00

12 min. 30 sec.

CELL NO. 56

Time	Amp.	Volt.
4:49	40	1.55
4:51		1.50
4:55		1.45
4:58		1.40
4:59:30		1.30
5:00		1.20
5:00:45		1.10
5:00:15		1.00

12 min. 15 sec.

CELL NO. 55

Time	Amp.	Volt.
5:02	40	1.65
5:05		1.65
5:06		1.65
5:07		1.60
5:10		1.60
5:11		1.50
5:15		1.40
5:17		1.20
5:18		1.15
5:18:20		1.00*

16 min. 20 sec.

Cells 55–56 off charge 4:45 p. m.

*NOTE on Cell 55.—During discharge a bad connection in voltmeter circuit was discovered on this cell. This discovery was made near end of discharge. After completion of discharge battery was still found not to be down to 1.00 Volt. with repaired connection. This battery would have gone longer than 16 min. 20 sec.

NOVEMBER 6, 1952.

Following cells on charge at 10:15 at 11 amps. (used two sides of charger for this). Water level in all cells brought exactly to ledge cast in case at start of charge.

CELL	49	50	45	46	53	54	47	48	Time
Gravity	1090	1130	1175	1120	1175	1100	No ledge		3:30
Water added, cc	44	Over ledge	12	38	Over ledge	42			5:00

CELL	44	42	55	56	103A	103B	Time
Gravity	1150	1050	1125	1100	1150	1175	3:40
Water added, cc	None	52	None	32	28	Over ledge	4:55

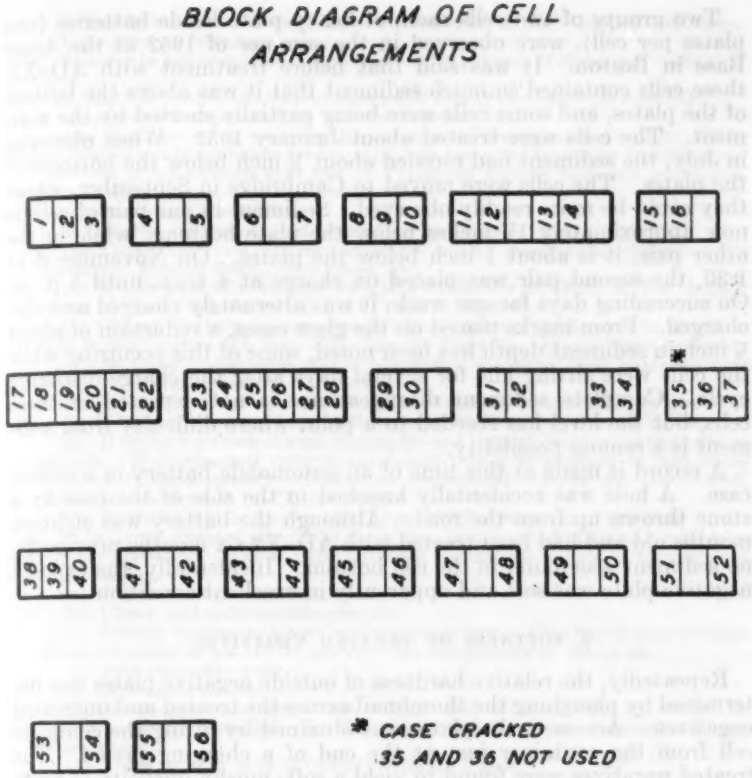
NOVEMBER 7, 1952.

At 10:20 again looked at water level in above cells. Level had dropped in several. Water level was once more brought up to reference ledge. Following amounts of water were necessary. Time 10:20–10:50 to do this.

CELL	49	50	45	46	53	54	47	48	44	43	55
CC Water	42	46	22	28	None		No ledge		26	22	34

CELL	56	103A	103B
CC Water	32	34	34

Above cells require approximately 800 cc. of electrolyte to bring level to ledge with plates in place in cell.



November 6-25.

General Experiments of Long Duration

1. Disappearance of Sediment

A small, glass-cased Willard thick plate cell, approximately 15 years old, had been left in an uncharged condition for several years. Well over an inch of sediment had collected in the bottom of the cell, and the liquid level had fallen over 2 inches below the tops of the plates. Distilled water was added to restore the level. Battery AD–X2 was added to the cell, and the unit placed on charge at 3 amperes. In several hours sediment reduction was evident, and by the time the cell was fully charged, the sediment was less than ¼ inch deep in the cell bottom. This occurred in May 1952. During the present series of tests, this cell was again examined, and it was evident to those present and also present when the cell was originally charged after treatment, that sediment has shown a further considerable decrease. The cell has not been recharged.

Two groups of two cells each, of heavy plate Exide batteries (two plates per cell), were observed in the summer of 1952 at the Army Base in Boston. It was said that before treatment with AD–X2, these cells contained so much sediment that it was above the bottom of the plates, and some cells were being partially shorted by the sediment. The cells were treated about January 1952. When observed in July, the sediment had receded about ½ inch below the bottoms of the plates. The cells were moved to Cambridge in September, where they could be more readily observed. Sediment in one pair of cells is now approximately 1¼ inches below the plate bottoms, while in the other pair, it is about 1 inch below the plates. On November 6 at 1:30, the second pair was placed on charge at 4 amp. until 5 p. m. On succeeding days for one week, it was alternately charged and discharged. From marks placed on the glass cases, a reduction of about ⅛ inch in sediment depth has been noted, some of this occurring while the cells were sitting idle for several days after the charge-discharge cycle. Complete sediment disappearance is not expected in these cells, but the level has receded to a point where difficulty from sediment is a remote possibility.

A record is made at this time of an automobile battery in a rubber case. A hole was accidentally knocked in the side of the case by a stone thrown up from the road. Although the battery was eighteen months old and had been treated with AD–X2 six months previously, no sediment was found in the cell bottom. Incidentally, the exposed negative plate was soft and apparently in excellent condition.

2. SOFTNESS OF TREATED NEGATIVES

Repeatedly, the relative hardness of outside negative plates was determined by ploughing the thumbnail across the treated and untreated negatives. Access to the plates was obtained by lifting the complete cell from the container just at the end of a charging period. The treated negatives were found to yield a soft, mushy quantity of paste by this procedure, while untreated negatives were hard, if sulfated, and yielded no such ploughed-up material. Sometimes the soft spots were found only at the plate edges of the treated negatives.

EXHIBIT 11

The following letter dated August 5, 1948, from War Department, Office of the Chief of Ordnance, Washington 25, D. C., was sent to the following five base depots:

(*a*) Atlanta General Distribution Depot, Atlanta, Ga.
(*b*) Benicia Arsenal, Benicia, Calif.
(*c*) Letterkenny Ordnance Depot, Chambersburg, Pa.
(*d*) Mount Rainer Ordnance Depot, Tacoma, Wash.
(*e*) Red River Arsenal, Texarkana, Tex.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ORDNANCE,
Washington 25, D. C., August 5, 1948.

Subject: Letter Report on Field Service Test of Transport Vehicle Batteries Containing Protecto-Charge.
To: Commanding Officer, Benicia Arsenal, Benicia, Calif.

1. This office has directed the purchase and shipment of a quantity of "Protecto-Charge" to your installation. It is requested that a field service test be initiated at your installation and letter reports be forwarded to this office as outlined below:

2. Protecto-Charge is a commercial product which claims:

(*a*) Reduces harmful effect of "sulfation."

(*b*) Ordinarily increases the capacity of mechanically sound "sulfated" batteries.
(*c*) Helps prevent freezing.
(*d*) Restores to active service, approximately 70 percent of discarded "sulfated" batteries.
(*e*) Lessens the chance of buckled plates and slowly decreases battery mud.
(*f*) Lengthens life expectancy of new batteries.

3. Other tests are being made by Research and Development Division, OCO. Similar tests to one listed below are being initiated at other Ordnance Installations.

4. Method of conducting field test of Transport Vehicle batteries containing Protecto-Charge:

(*a*) 40 batteries will be tested.

(1) 10 batteries selected should be ready for salvage.

(a) These batteries should have no visual mechanical defects. For Example: Broken Posts, Split Cases, etc.

(b) Check and note voltage by using voltmeter as listed in TM 9–2857 dated 15 May 1945, Part II, Sec. IV, Par. 13, Page 18.

(c) Charge battery in accordance with "cycling" technique as listed in TM 9–2857. Part III, Sec. VIII, Par. 32, Page 32. Do not flush batteries.

(d) As these 10 batteries should not accept a charge, treat batteries with Protecto-Charge. See (*c*) (8) below.

(e) Follow "cycling" technique again as listed in (*c*) immediately above.

(f) If battery accepts charge follow instructions as listed in (*b*) below.

(g) If battery refuses charge, dismantle and inspect battery for mechanical defects. If mechanical defects are found repeat this phase of test using another salvage battery. When no mechanical defects are discovered; follow instructions in (*c*) (7) (a) below.

(h) Batteries will be known as a Type "A" for purposes of this test.

(2) 10 batteries selected should be those now in use on administrative vehicles in everyday operation. Age of these batteries immaterial so long as they are not absolutely *new*.

(a) Check battery condition.

(b) Check and note specific gravity.

(c) Submit battery to a high rate discharge test. Check and note voltage. Same reference as 4.a (1) (b) above. Do not prolong to discharge.

(d) Add necessary water.

(e) Service terminals.

(f) Check generator maximum voltage and charging rate on vehicle in which battery is installed. Service and correct to proper standard readings if necessary.

(g) Make written note of battery expiration date.

(h) Treat batteries with Protecto-Charge. See c (8) below.

(i) Batteries will be known as a Type "B" for purposes of this test.

(3) 20 batteries selected should be new.

(a) Select batteries of approximate expiration date insofar as practicable. See SB 9–73 for serviceability standards.

(b) Service batteries according to instructions for type, whether wet stored or dry stored, etc.

(c) Check and note specific gravity.

(d) Check and note voltage as listed in 4.a (1) (b) above.

(e) Check generator maximum voltage and charging rate on test vehicle. Service and correct to proper standard readings if necessary.

(f) Treat *only* 10 *new* batteries with Protecto-Charge.

(g) Batteries in (f) immediately above will be known as Type "C" for purposes of this test.

(h) Do *not* treat 10 *new* batteries with Protecto-Charge.

REASON: For comparison with (f) immediately above.

(i) Batteries in (h) immediately above will be known as Type "D" for purposes of this test.

(4) Batteries should be painted with an appropriate symbol, letter, and date of test.

(*b*) 30 Batteries as listed in a. (1) (3) (Types "A," "C," "D" above) should be installed in administrative vehicles used every day in the immediate locality of the installation making the test.

(1) Batteries in (*a*) (2) Type "B" above. Reinstall after following directions.

(2) Type of vehicles are immaterial for test so long as a log or record is kept of the vehicle and its battery being tested at all times during test.

(*c*) Batteries will be used in normal manner of operation in the vehicle.

(1) No special runs, extremes of conditions are desired nor authorized other than those normally met by any vehicle in that installation during the course of its everyday operation.

(2) A battery being tested will not be removed, recharged or salvaged without making an entry in the log of the vehicle in which that battery had been installed. Indicate action taken.

(3) All batteries listed in 4.a above will be installed in selected vehicles on the same day as the test is to be started insofar as practicable.

(4) Test will be continued for 6 months after date of start of test.

(5) Test will be initiated as soon as practicable after receipt of this information and receipt of shipment of Protecto-Charge envelopes.

(6) If battery being tested has to be removed from any vehicle permanently because of absolute failure to function, take a charge, etc.; no other battery containing Protecto-Charge will be installed in this vehicle for purposes of this test. That particular vehicle and its battery will be considered to be finished insofar as this test is concerned.

(7) On date test is started, a list of the vehicles as to type, U. S. Registration No., etc., will be made showing nomenclature and type of battery as listed in 4.a. (1) (2) (3) above has been installed.

(a) It is obvious, if any batteries as listed in 4.a. (1) Type "A" will not take a charge, a notation to that effect will be listed and the test closed insofar as those particular batteries are concerned, provided that this failure is not due to mechanical defects in the battery. See 4.a. (1) (g) above.

(8) Batteries containing Protecto-Charge being charged initially and during test will be in accordance with manufacturer's directions listed below:

(a) Clean top of battery and posts.

(b) Cover plates with water.

(c) Empty one envelope into each cell. (See incl. #1.)

(d) Dissolve "Protecto-Charge" on top of plates with battery syringe.

(e) Immediately start motor and set throttle to charge at 10 amps., allow to charge for 30 minutes to blend "Protecto-Charge" with battery acid.

(f) Fully charge at not more than 40 amps. when charger is used.

(9) Each battery will be tested for specific gravity once during each week and generator maximum voltage and charging rate noted in log of that battery.

(10) Failed batteries or batteries surviving at end of 6 months test.

(a) When a battery fails or completes 6 months test, replace with nontest battery. Make written note of generator maximum voltage and charging rate; whether battery is Type "A," "B," "C," or "D," date of failure or end of test.

(b) Check and note specific gravity.

(c) Check cell breakdown rate. Make note of defective cells, if any.

(d) Drain electrolyte from individual cells into 1 qt. mason jars (fruit jars). Mark jars with cell number and battery number or symbol.

(e) Dismantle battery, pull individual cells. Add sludge from cell to mason jar containing its electrolyte. See (d) immediately above.

(f) Wash plates from each cell in water. Add this water and sludge to same jar containing its electrolyte. See (d) above.

(g) Let stand undisturbed for 24 hours. Measure depth of sediment with wooden rule. If impossible to measure, estimate and/or describe in log of battery.

(h) Indicate type of separators; wood, perforated rubber, or spun glass.

(*d*) Letter reports:

(1) Copy of initial list as indicated in 4.b. (2) and 4.c. (7) above together with information indicated in 4.a. (1), (2), (3) will be forwarded to this office as soon as practicable after initiation of the test on attached letter forms. (Incl. #2.)

(a) Use as many letter forms as necessary, however conserve space where practicable.

(2) Monthly letter reports will be submitted thereafter to this office on the 40 batteries being tested.

(a) Submit report not later than 10th of the month following that for which the report is rendered.

(3) Explanatory notes as to apparent or actual reasons for batteries requiring recharging, failures, and permanent removal will be added as footnotes to bottom of letter form.

(4) Where a battery from this test has been dismantled during any month of the test, the observations may be either included with the monthly letter report, if available, or forwarded with the next monthly letter report. In the latter instance, make appropriate reference to identify battery.

(5) At completion of test use these forms to forward information as directed.

(6) Should vehicle and testing battery be transferred from the installation, placed in a nonactive motor pool, wrecked, etc., include this information under remarks and/or explanatory notes.

(7) Explanation of letter report form.

(a) Complete information under par. 1, regarding month for which report is rendered.

(b) Column 1 for line numbers (1 through 40).

(c) Column 2 includes nomenclature and U. S. Registration number. (Example: Lt. sedan, 12550.)

(d) Column 3 include battery type as listed in TM 9–2857 Part II, Section 5 and type for identification for test purposes. See a. (1) (h), etc. (Example: 2H/C/.)

(e) Column 4 list voltage reading as obtained from high-grade discharge tester or voltmeter by cell. (Example: 1.9, 1.0, 1.5.)

(f) Column 5 list number of times battery received a charge or charges for month for which report is being rendered. (Example: 0.)

(g) Column 6 list specific gravity as obtained from weekly check. (Example: 1.240, 1.245, 1.260, 1.250, 1.250, 1.245, 1.250, 1.221, 1.245, 1.240, 1.250, 1.240.)

(h) Column 7, list date battery was removed from vehicle. Appropriate remark entry in column 8 should be made. (Example: 9/5/48, Failure.)

(i) Column 8 under "Remarks" Include information to explain column 1 through 7 for a particular battery. See 4.c. (10) and 4.d. (4) above.

(Example: See Ex. Note # 1.)

(Example: Note # 1: Battery being dismantled report to be forwarded next month.)

By Command of Major General Hughes:

[s] F. M. Humphries,
[t] F. M. Humphries,
Lt. Col., Ord. Dept., Assistant.

2 Incl.
1. Protecto-Charge chart.
2. Letter Form.

LETTER REPORTS ON FIELD SERVICE TEST OF PROTECTO-CHARGE (AD–X2) FROM ATLANTA GENERAL DISTRIBUTION DEPOT, ATLANTA, GA.

To: OCO, attn: Field Service Division, Maint. Br., Auto Sect.
Subject: Letter report on Field Service Test of Transport Vehicle Batteries containing Protecto-Charge.

1. Forwarded is information requested in basic letter, subject as above for month ending February 28, 1949.

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
1	Chev. B. S., USA 0023405	4–H	A	(1) 2.1, 2.1		1.260	1.200				Feb. 9, 1949	Failed, see explanatory note No. 1.
				(2) 2.1, 1.8		1.260	1.165					
				(3) 2.2, 2.0		1.265	1.190					
2	GMC–Cargo, USA 455893	4–H	A	(1) 1.8		1.100					Feb. 7, 1949	Failed, see explanatory note No. 2.
				(2) 2.0		1.200						
				(3) 1.8		1.160						
3	Int. Bus., USA 20664991	4–H	A	(1) 2.2, 2.2, 2.3		1.270	1.270	1.260	1.285			
				(2) 2.2, 2.2, 2.3		1.270	1.250	1.270	1.285			
				(3) 2.2, 2.2, 2.2		1.270	1.270	1.270	1.260			
4	Int. Bus., USA 20664810	4–H	A	(1) 2.2, 2.1, 2.1, 2.2		1.245	1.245	1.260	1.240			
				(2) 2.2, 2.2, 2.2, 2.2		1.245	1.260	1.260	1.260			
5	Dia. T. Wrecker, USA 007068.	4–H	A	(3) 2.2, 2.2, 2.2, 2.2		1.245	1.260	1.250	1.260			
				(1) 1.8		1.160					Feb. 4, 1949	Failed, see explanatory note No. 3. 2 each batteries installed in Dia. T. Wr., see lines 5 and 6.
				(2) 1.8		1.150						
6				(3) 1.8		1.160						
	Dia. T. Wrecker, USA 007068.	4–H	A	(1) 1.9		1.170					do	Failed, see explanatory note No. 3.
				(2) 1.9		1.170						
7				(3) 1.8		1.200						
	Dia. T. Wrecker, USA 0010131.	4–H	A	(1) 2.2		1.260					do	Failed, see explanatory note No. 4. 2 batteries in Dia. T., lines 7 and 8.
				(2) 1.9		1.180						
				(3) 2.0		1.260						
8	Dia. T. Wrecker, USA 0010131.	4–H	A	(1) 2.1, 1.9		1.100	1.185				Feb. 11, 1949	Failed, see explanatory note No. 5
				(2) 2.1, 2.0		1.230	1.200					
				(3) 2.1, 2.0		1.220	1.220					
9	Ford S. & P., USA 344359	2–H	A	(1) 2.2		1.260					Feb. 4, 1949	Failed, see explanatory note No. 6.
				(2) 1.7		1.180						
				(3) 2.1		1.250						
10	Jeep C. & R., USA 20766808	2–H	A	(1) 2.1, 2.2, 2.2, 2.2		1.240	1.220	1.220	1.260			
				(2) 2.1, 2.1, 2.1, 2.2		1.245	1.240	1.240	1.240			
				(3) 2.2, 2.2, 2.2, 2.2		1.260	1.260	1.260	1.230			

11	Chev. B. S., USA 0037672	4–H	B	(1) 2.2, 2.2, 2.2, 2.0		1.260	1.240	1.260	1.185		
				(2) 2.2, 2.2, 2.0, 2.0		1.260	1.240	1.220	1.220		
				(3) 2.1, 2.0, 2.2, 2.1		1.245	1.200	1.250	1.225		
12	Chev. B. S., USA 0024387	4–H	B	(1) 2.2, 2.1, 2.2, 2.2		1.260	1.240	1.250	1.250		
				(2) 2.2, 2.1, 2.2, 2.2		1.260	1.240	1.245	1.250		
				(3) 2.2, 2.2, 2.2, 2.2		1.260	1.260	1.220	1.260		
13	Chev. B. S., USA 0062023	4–H	B	(1) 2.1, 2.0, 2.2, 2.0		1.220	1.200	1.220	1.185		
				(2) 2.2, 2.1, 2.2, 2.1		1.220	1.225	1.220	1.220		
				(3) 2.1, 2.1, 2.2, 2.1		1.240	1.225	1.240	1.230		
14	Chev B. S., USA 0024390	4–H	B	(1) 2.3, 2.3, 2.3, 2.3		1.285	1.300	1.265	1.280		
				(2) 2.3, 2.3, 2.3, 2.3		1.285	1.300	1.275	1.280		
				(3) 2.3, 2.3, 2.3, 2.3		1.285	1.300	1.280	1.285		
15	Chev B. S., USA 004633	4–H	B	(1) 2.2, 2.2, 2.2, 2.3		1.240	1.265	1.250	1.280		
				(2) 2.2, 2.2, 2.2, 2.3		1.240	1.265	1.250	1.280		
				(3) 2.2, 2.2, 2.2, 2.3		1.240	1.265	1.250	1.280		
16	Chev B. S., USA 0036915	4–H	B	(1) 2.2, 2.2, 2.2, 2.2		1.240	1.240	1.230	1.220		
				(2) 2.2, 2.2, 2.2, 2.2		1.240	1.240	1.245	1.230		
				(3) 2.2, 2.1, 2.2, 2.2		1.240	1.220	1.260	1.225		
17	Chev B. S., USA 0062191	4–H	B	(1) 2.3		1.200				Feb. 2, 1949	Failed, see explanatory note No. 7.
				(2) 1.7		1.080					
				(3) 2.3		1.200					
18	Chev B. S., USA 0012194	4–H	B	(1) 2.2, 2.2, 2.2, 2.2		1.260	1.240	1.230	1.245		
				(2) 2.2, 2.2, 2.2, 2.2		1.260	1.240	1.220	1.230		
				(3) 2.2, 2.1, 2.1, 2.2		1.255	1.225	1.220	1.230		
19	Chev B. S., USA 0036912	4–H	B	(1) 2.2, 2.2, 2.2, 2.3		1.260	1.260	1.255	1.270		
				(2) 2.2, 2.2, 2.2, 2.3		1.260	1.260	1.255	1.270		
				(3) 2.2, 2.2, 2.3, 2.2		1.260	1.285	1.270	1.250		
20	Chev. Dump, USA 3486794	4–H	B	(1) 2.2, 2.1, 2.3, 2.2		1.240	1.230	1.280	1.240		
				(2) 2.1, 2.2, 2.3, 2.2		1.220	1.235	1.260	1.240		
				(3) 2.2, 2.1, 2.3, 2.2		1.240	1.230	1.260	1.240		
21	Chev. B. S., USA 0023356	4–H	C	(1) 2.2, 2.2, 2.2, 2.2		1.245	1.240	1.240	1.220		
				(2) 2.2, 2.2, 2.2, 2.2		1.245	1.240	1.240	1.230		
				(3) 2.2, 2.2, 2.2, 2.2		1.245	1.240	1.235	1.230		
22	Chev. B. S., USA 0037167	4–H	C	(1) 2.2, 2.2, 2.2, 2.2		1.260	1.260	1.260	1.240		
				(2) 2.2, 2.2, 2.2, 2.2		1.260	1.260	1.260	1.245		
				(3) 2.2, 2.2, 2.2, 2.2		1.260	1.265	1.270	1.240		
23	Chev. B. S., USA 0062257	4–H	C	(1) 2.3, 2.3, 2.3, 2.3		1.290	1.300	1.295	1.300		
				(2) 2.3, 2.3, 2.3, 2.3		1.280	1.285	1.295	1.300		
				(3) 2.3, 2.3, 2.2, 2.3		1.280	1.300	1.290	1.300		
24	Chev. Dump, USA 3102711	4–H	C	(1) 2.2, 2.2, 2.2, 2.2		1.260	1.240	1.260	1.265		
				(2) 2.2, 2.2, 2.2, 2.2		1.250	1.240	1.260	1.260		
				(3) 2.2, 2.2, 2.2, 2.2		1.250	1.250	1.240	1.250		
25	Chev. Dump, USA 3486532	4–H	C	(1) 2.2, 1.9, 2.3, 2.1		1.240	1.100	1.280	1.200		Charged, removed week Feb. 7, 1949.
				(2) 2.2, 1.9, 2.3, 2.2		1.250	1.100	1.280	1.220		
				(3) 2.2, 1.9, 2.3, 2.2		1.240	1.120	1.220	1.220		
26	Ford C, USA 3154673	2–H	C	(1) 2.3, 2.3, 2.3, 2.3		1.290	1.280	1.280	1.285		
				(2) 2.3, 2.3, 2.3, 2.3		1.290	1.280	1.280	1.285		
				(3) 2.3, 2.3, 2.3, 2.3		1.290	1.280	1.280	1.300		
27	Jeep ¼, USA 20506040	2–H	C	(1) 2.3, 2.3, 2.3, 2.3		1.285	1.280	1.270	1.285		Chg. Feb. 14.
				(2) 2.3, 2.3, 2.3, 2.3		1.285	1.280	1.270	1.285		
				(3) 2.3, 2.3, 2.3, 2.3		1.285	1.280	1.270	1.300		

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
28	Jeep ¼, USA 20734770	2-H	C	(1) 2.2, 2.1, 2.2		1.265	1.220	1.240				B. O. L. left on dead (returned to stock).
				(2) 2.2, 2.1, 2.2		1.265	1.220	1.240				
				(3) 2.2, 2.1, 2.2		1.265	1.220	1.245				
29	Dodge P. U., USA 2180238	2-H	C	(1) 2.2, 2.2, 2.3, 2.3		1.280	1.260	1.270	1.260			
				(2) 2.2, 2.2, 2.3, 2.3		1.280	1.260	1.270	1.260			
				(3) 2.2, 2.2, 2.3, 2.3		1.285	1.260	1.280	1.265			
30	Jeep ¼, USA 20679846	2-H	C	(1) 2.2, 1.9, 2.3, 2.3		1.280	1.180	1.285	1.300			Removed from charge Feb. 14, USA 2266943.
				(2) 2.2, 1.9, 2.3, 2.3		1.280	1.180	1.280	1.300			
				(3) 2.2, 1.9, 2.3, 2.3		1.280	1.185	1.275	1.285			
31	Jeep ¼, USA 20153979	2-H	D	(1) 2.3, 2.3, 2.3, 2.3		1.280	1.280	1.290	1.280			
				(2) 2.3, 2.3, 2.3, 2.3		1.280	1.280	1.290	1.280			
				(3) 2.3, 2.3, 2.3, 2.3		1.280	1.280	1.285	1.275			
32	Jeep ¼, USA 20268509	2-H	D	(1) 2.3, 2.3, 2.3, 2.3		1.285	1.280	1.270	1.300			
				(2) 2.3, 2.3, 2.3, 2.3		1.285	1.280	1.270	1.285			
				(3) 2.3, 2.2, 2.3, 2.3		1.285	1.270	1.260	1.280			
33	Jeep ¼, USA 20721611, USA 023405.	2-H	D	(1) 2.2, 2.3		1.280			1.285			Returned to stock Feb. 10, 1949. Installed in Chev. B. S., USA 023405 Feb. 22, 1949.
				(2) 2.2, 2.3		1.280			1.285			
				(3) 2.2, 2.3		1.275			1.285			
34	Chev P. U., USA 2271226	1-M	D	(1) 2.3, 2.3, 2.3, 2.2		1.300	1.280	1.270	1.245			
				(2) 2.3, 2.3, 2.3, 2.2		1.300	1.280	1.270	1.245			
				(3) 2.3, 2.3, 2.3, 2.3		1.300	1.280	1.275	1.260			
35	Ford P. U., USA 252456	2-H	D	(1) 2.1, 2.0, 2.2, 2.2		1.250	1.170	1.260	1.220			Charged February 21.
				(2) 2.2, 2.0, 2.2, 2.2		1.245	1.170	1.260	1.230			
				(3) 2.2, 2.0, 2.2, 2.2		1.250	1.190	1.260	1.240			
36	Chev B. S., USA 0012034	4-H	D	(1) 2.3, 2.3, 2.3, 2.4		1.285	1.270	1.280	1.300			
				(2) 2.3, 2.3, 2.3, 2.4		1.285	1.270	1.280	1.300			
				(3) 2.3, 2.3, 2.3, 2.4		1.285	1.275	1.280	1.300			
37	Chev B. S., USA 0037036	4-H	D	(1) 2.2, 2.2, 2.2, 2.2		1.265	1.265	1.260	1.250			
				(2) 2.2, 2.2, 2.2, 2.2		1.265	1.265	1.240	1.250			
				(3) 2.2, 2.2, 2.2, 2.2		1.275	1.270	1.260	1.260			
38	Chev. P. U., USA 297458	1-M	D	(1) 2.2, 2.2, 2.3, 2.3		1.270	1.265	1.270	1.260			
				(2) 2.2, 2.2, 2.2, 2.3		1.270	1.260	1.260	1.260			
				(3) 2.2, 2.2, 2.3, 2.3		1.260	1.265	1.270	1.260			
39	Ford S. & P., USA 3144872	2-H	D	(1) 2.2, 2.2, 2.2, 2.3		1.260	1.265	1.260	1.265			Charged Feb. 7, 1949.
				(2) 2.2, 2.2, 2.2, 2.3		1.260	1.265	1.260	1.265			
				(3) 2.2, 2.2, 2.2, 2.3		1.260	1.265	1.250	1.260			
40	Chev. P. U., USA 2262637	1-M	D	(1) 2.2, 2.2		1.260	1.265					Removed to USA 2269563.
				(2) 2.2, 2.2		1.260	1.265					
				(3) 2.2, 2.2		1.260	1.260					

41	Chev. P. U., USA 2269563	1–M	D	(1) 2.3, 2.3 (2) 2.3, 2.3 (3) 2.3, 2.3				1.270 1.270 1.270	1.280 1.280 1.280			Removed from USA 2262637, line No. 40.

EXPLANATORY NOTES

No. 1. Failed in service, would not take recharge, battery dismantled, sludge measured in 1 quart jars. Cell No. 1, 5/16 inch; No. 2, 1/8 inch; No. 3, 1/8 inch.

No. 2. Failed in service, would not take recharge, battery dismantled, sludge measured in 1 quart jars. Cell No. 1, 1/4 inch; No. 2, 1/8 inch; No. 3, 1/4 inch.

No. 3. 2 batteries failed simultaneously, both dismantled, sludge measured in 1 quart jars.

Line No. 5. Cell No. 1, 1/4 inch; No. 2, 5/16 inch; No. 3, 5/16 inch.

Line No. 6. Cell No. 1, 1/4 inch; No. 2, 5/16 inch; No. 3, 1/4 inch.

No. 4. Line No. 7 failed in service, dismantled, sludge measured in 1 quart jars. Cell No. 1, 5/16 inch; No. 2, 1/4 inch; No. 3, 5/16 inch.

No. 5. Line No. 8 failed in service, dismantled, sludge measured in 1 quart jars. Cell No. 1, 5/16 inch; No. 2, 5/16 inch; No. 3, 5/16 inch.

No. 6. Line No. 9 failed in service, dismantled, sludge measured in 1 quart jars. Cell No. 1, 5/16 inch; No. 2, 1/8 inch; No. 3, 5/16 inch.

No. 7. Line No. 17 failed in service, battery dismantled, sludge measured in 1 quart jar. Cell No. 1, 1/8 inch; No. 2, 5/16 inch; No. 3, 5/16 inch.

To: OCO, attn: Field Service Division, Maint Br, Auto Sect.
Subject: Letter report on Field Service Test of Transport Vehicle Batteries containing Protecto-Charge
1. Forwarded is information requested in basic letter, subject as above for month ending Apr. 29, 1949.

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
1	Int. Bus., USA 20664991	4–H	A	(1) 2.2, 2.2, 2.2, 2.1		1.240	1.220	1.260	1.220			
				(2) 2.2, 2.2, 2.3, 2.2		1.240	1.240	1.260	1.240			
				(3) 2.2, 2.3, 2.3, 2.3		1.220	1.260	1.250	1.260			
2	Int. Bus., USA 20664810	4–H	A	(1) 2.3, 2.3, 2.3, 2.2		1.270	1.265	1.260	1.240			
				(2) 2.3, 2.3, 2.3, 2.2		1.270	1.265	1.260	1.240			
				(3) 2.3, 2.3, 2.3, 2.3		1.270	1.265	1.260	1.260			
3	Jeep C. & R., USA 20766808	2–H	A	(1) 2.2, 2.2, 2.2, 2.1		1.240	1.245	1.240	1.220			
				(2) 2.2, 2.2, 2.2, 2.1		1.240	1.220	1.240	1.220			
				(3) 2.1, 2.0, 2.0, 2.2		1.200	1.200	1.210	1.240			
4	Chev. B. S., USA 0037672	4–H	B	(1) 2.2, 2.1, 2.0, 2.2		1.220	1.200	1.240	1.240			
				(2) 2.2, 2.1, 2.1, 2.2		1.240	1.210	1.220	1.240			
				(3) 2.1, 2.2, 2.2, 2.3		1.200	1.240	1.240	1.260			
5	Chev. B. S., USA 0024387	4–H	B	(1) 2.3, 2.3, 2.2, 2.3		1.260	1.260	1.250	1.260			
				(2) 2.3, 2.3, 2.2, 2.3		1.260	1.270	1.250	1.260			
				(3) 2.2, 2.2, 2.2, 2.2		1.240	1.245	1.240	1.240			
6	Chev. B. S., USA 0062023	4–H	B	(1) 2.0, 2.3, 2.2, 2.3		1.180	1.280	1.240	1.260			Switch left on, removed, recharged Apr. 11, 1949.
				(2) 2.0, 2.3, 2.2, 2.3		1.180	1.280	1.240	1.260			
				(3) 2.0, 2.2, 2.3, 2.3		1.200	1.260	1.260	1.260			
7	Chev. B. S., USA 0024390	4–H	B	(1) 2.3, 2.4, 2.3, 2.3		1.280	1.300	1.280	1.280			
				(2) 2.3, 2.4, 2.3, 2.3		1.280	1.300	1.280	1.280			
				(3) 2.3, 2.4, 2.3, 2.3		1.275	1.300	1.280	1.280			
8	Chev. B. S., USA 004633	4–H	B	(1) 2.3, 2.3, 2.3, 2.3		1.260	1.280	1.260	1.260			
				(2) 2.3, 2.3, 2.3, 2.3		1.260	1.280	1.260	1.280			
				(3) 2.4, 2.3, 2.3, 2.3		1.280	1.280	1.260	1.280			
9	Chev. B. S., USA 0036915	4–H	B	(1) 2.2, 2.2, 2.2, 2.2		1.220	1.240	1.245	1.240			
				(2) 2.2, 2.2, 2.2, 2.2		1.240	1.240	1.245	1.240			
				(3) 2.3, 2.2, 2.2, 2.2		1.260	1.245	1.240	1.245			
10	Chev. B. S., USA 0012194	4–H	B	(1) 2.2, 2.2, 2.3, 2.1		1.245	1.240	1.260	1.220			
				(2) 2.2, 2.2, 2.3, 2.2		1.245	1.240	1.260	1.220			
				(3) 2.3, 2.1, 2.2, 2.2		1.260	1.220	1.240	1.240			
11	Chev. B. S., USA 0036912	4–H	B	(1) 2.3, 2.3, 2.2, 2.2		1.260	1.280	1.240	1.240			
				(2) 2.3, 2.3, 2.2, 2.2		1.260	1.270	1.240	1.240			
				(3) 2.2, 2.2, 2.3, 2.1		1.240	1.245	1.260	1.220			
12	Chev. Dump, USA 3486794	4–H	B	(1) 2.2, 2.2, 2.2, 2.2		1.240	1.240	1.240	1.240			
				(2) 2.2, 2.2, 2.2, 2.2		1.240	1.240	1.240	1.240			
				(3) 2.2, 2.2, 2.3, 2.3		1.240	1.240	1.260	1.260			
13	Chev. B. S., USA 0023356	4–H	C	(1) 2.2, 2.2, 2.3		1.220	1.220	1.260	1.220			
				(2) 2.2, 2.2, 2.3		1.220	1.220	1.260	1.220			
				(3) 2.2, 2.2, 2.3		1.200	1.240	1.250	1.240			
14	Chev. B. S., USA 0037167	4–H	C	(1) 2.2, 2.2, 2.2, 2.2		1.240	1.240	1.245	1.240			
				(2) 2.2, 2.2, 2.2, 2.2		1.240	1.240	1.240	1.240			
				(3) 2.2, 2.2, 2.2, 2.2		1.245	1.240	1.240	1.240			
15	Chev. B. S., USA 0063257	4–H	C	(1) 2.3, 2.3, 2.3, 2.2		1.270	1.290	1.260	1.240			

14	Chev. B. S., USA 0037167	4–H	C	(3) 2.2, 2.2, 2.3		1.240	1.240	1.250	1.240		
				(1) 2.2, 2.2, 2.2, 2.2		1.240	1.240	1.245	1.240		
				(2) 2.2, 2.2, 2.2, 2.2		1.240	1.240	1.240	1.240		
				(3) 2.2, 2.2, 2.2, 2.2		1.245	1.240	1.240	1.240		
15	Chev. B. S., USA 0062257	4–H	C	(1) 2.3, 2.3, 2.3, 2.2		1.270	1.290	1.260	1.240		
				(2) 2.3, 2.3, 2.3, 2.2		1.270	1.290	1.260	1.240		
				(3) 2.3, 2.3, 2.3, 2.2		1.270	1.290	1.265	1.240		
16	Chev. Dump, USA 3102711	4–H	C	(1) 2.2, 2.2, 2.3, 2.2		1.245	1.240	1.260	1.240		
				(2) 2.2, 2.2, 2.3, 2.2		1.245	1.240	1.260	1.245		
				(3) 2.3, 2.1, 2.2, 2.2		1.260	1.220	1.250	1.240		
17	Chev. Dump, USA 3486532	2–H	C	(1) 2.2, 2.3, 2.2, 2.1		1.240	1.260	1.240	1.200		
				(2) 2.2, 2.3, 2.2, 2.1		1.240	1.260	1.240	1.220		
				(3) 2.2, 2.2, 2.1, 2.1		1.220	1.250	1.220	1.220		
18	Ford C., USA 2154673	2–H	C	(1) 2.3, 2.3, 2.3, 2.3		1.265	1.280	1.280	1.280		
				(2) 2.3, 2.3, 2.3, 2.3		1.265	1.280	1.280	1.280		
				(3) 2.3, 2.3, 2.3, 2.3		1.265	1.280	1.280	1.280		
19	Jeep C. & R., USA 20596040	2–H	C	(1) 2.3, 2.3, 2.3, 2.3		1.270	1.280	1.280	1.280		
				(2) 2.4, 2.3, 2.3, 2.3		1.280	1.280	1.280	1.280		
				(3) 2.4, 2.3, 2.3, 2.3		1.285	1.280	1.280	1.260		
20	Chev. P. V., USA 295581	2–H	C	(1) 2.3, 2.3, 2.3, 2.2		1.265	1.260	1.260	1.240		
				(2) 2.3, 2.3, 2.3, 2.2		1.265	1.260	1.260	1.240		
				(3) 2.3, 2.3, 2.3, 2.2		1.270	1.260	1.260	1.250		
21	Ford S. & P., USA 3283846	2–H	C	(1) 2.4, 2.3, 2.3, 2.3		1.280	1.260	1.260	1.280		
				(2) 2.4, 2.3, 2.3, 2.3		1.280	1.260	1.260	1.280		
				(3) 2.4, 2.3, 2.2, 2.3		1.285	1.260	1.255	1.280		
22	Jeep C. & R., USA 20679846	2–H	C	(1) 2.3, 2.3, 2.3, 2.3		1.270	1.260	1.260	1.260		
				(2) 2.3, 2.3, 2.3, 2.3		1.270	1.260	1.260	1.260		
				(3) 2.3, 2.3, 2.3, 2.3		1.270	1.265	1.270	1.280		
23	Jeep C. & R., USA 20153979	2–H	D	(1) 2.3, 2.3, 2.3, 2.3		1.260	1.270	1.260	1.260		
				(2) 2.3, 2.3, 2.3, 2.3		1.260	1.270	1.260	1.260		
				(3) 2.3, 2.3, 2.3, 2.3		1.250	1.265	1.260	1.280		
24	Jeep C. & R., USA 20268509	2–H	D	(1) 2.4, 2.3, 2.2, 2.3		1,285	1,260	1,240	1,260		
				(2) 2.4, 2.3, 2.2, 2.3		1.285	1.260	1.240	1.260		
				(3) 2.4, 2.3, 2.2, 2.3		1,280	1.260	1.240	1.260		
25	Chev. B. S., USA 0023405	2–H	D	(1) 2.3, 2.3, 2.3, 2.3		1.250	1.260	1.260	1.280		Removed from USA 00231.
				(2) 2.2, 2.3, 2.3, 2.3		1.250	1.260	1.260	1.260		
				(3) 2.2, 2.3, 2.3, 2.3		1.250	1.265	1.270	1.270		
26	Chev. P. V., USA 2271226	1M	D	(1) 2.2, 2.2, 2.3, 2.3		1.250	1.240	1.260	1.260		
				(2) 2.2, 2.2, 2.3, 2.3		1.250	1.240	1.260	1.260		
				(3) 2.2, 2.2, 2.3, 2.3		1.245	1.230	1.280	1.270		
27	Ford P. V., USA 252456	2–H	D	(1) 2.3, 2.3, 2.3, 2.3		1.260	1.260	1.280	1.260		
				(2) 2.3, 2.3, 2.3, 2.3		1.260	1.260	1.280	1.260		
				(3) 2.3, 2.3, 2.3, 2.3		1.260	1.260	1.270	1.260		
28	Chev. B. S., USA 0012034	4–H	D	(1) 2.4, 2.3, 2.3, 2.3		1.280	1.260	1.280	1.260		
				(2) 2.4, 2.3, 2.3, 2.3		1.280	1.260	1.280	1.260		
				(3) 2.3, 2.3, 2.3, 2.3		1.260	1.250	1.280	1.280		
29	Chev. B. S., USA 0037036	4–H	D	(1) 2.1, 2.2, 2.2, 2.2		1.220	1.220	1.240	1.220		
				(2) 2.2, 2.2, 2.2, 2.2		1.220	1.220	1.240	1.220		
				(3) 2.1, 2.2, 2.2, 2.2		1.220	1.220	1.240	1.220		
30	Chev. P. V., USA 297458	1–M	D	(1) 2.2, 2.3, 2.3, 2.2		1.250	1.260	1.260	1.240		
				(2) 2.2, 2.3, 2.3, 2.2		1.250	1.260	1.260	1.240		
				(3) 2.2, 2.3, 2.2, 2.2		1.250	1.260	1.250	1.240		
31	Ford S. & B., USA 3144872	2–H	D	(1) 2.4, 2.3, 2.3, 2.3		1.280	1.260	1.280	1.260		
				(2) 2.4, 2.3, 2.3, 2.3		1.280	1.260	1.280	1.260		
				(3) 2.4, 2.3, 2.3, 2.3		1.280	1.265	1.280	1.260		
32	Chev. P. V., USA 2269937	1–M	D	(1) 2.4, 2.4, 2.4, 2.4		1.280	1.285	1.280	1.280		
				(2) 2.4, 2.4, 2.4, 2.4		1.280	1.285	1.280	1.280		
				(3) 2.4, 2.4, 2.4, 2.4		1.285	1.285	1.280	1.285		

To: OCO, attn: Field Service Division, Maint Br. Auto Sect.
Subject: Letter report on Field Service Test of Transport Vehicle Batteries containing Protecto-Charge.
1. Forwarded is information requested in basic letter, subject as above for month ending May 31, 1949.

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C			1st week	2d week	3d week	4th week	5th week		
1	Int. Bus., USA 20664991	4-H	A	(1) 2.2, 2.1, 2.2, 2.3		1.245	1.220	1.220	1.260			
				(2) 2.2, 2.2, 2.2, 2.2		1.245	1.240	1.230	1.245			
				(3) 2.2, 2.2, 2.2, 2.2		1.240	1.250	1.240	1.245			
2	Int. Bus., USA 20664810	4-H	A	(1) 2.3, 2.1, 2.0, 2.2		1.250	1.200	1.160	1.240			
				(2) 2.3, 2.1, 2.0, 2.2		1.240	1.200	1.160	1.220			
				(3) 2.2, 2.2, 2.0, 2.2		1.240	1.220	[1] 1.160	1.230			
3	Jeep C. & R., USA 20766808	2-H	A	(1) 2.1, 2.2, 2.1, 2.1		1.200	1.240	1.200	1.200			
				(2) 2.1, 2.2, 2.0, 2.1		1.200	1.220	1.180	1.220			
				(3) 2.2, 2.2, 2.0, 2.2		1.220	1.200	[2] 1.180	1.240			
4	Chev. B. S., USA 0037672	4-H	B	(1) 2.0, 2.2, 2.3, 2.2		1.180	1.250	1.220	1.230			
				(2) 2.0, 2.2, 2.3, 2.2		1.180	1.250	1.220	1.230			
				(3) 2.0, 2.2, 2.3, 2.2		[3] 1.180	1.250	1.220	1.230			
5	Chev. B. S., USA 00243387	4-H	B	(1) 2.2, 2.3, 2.2, 2.2		1.220	1.250	1.250	1.240			
				(2) 2.3, 2.2, 2.2, 2.2		1.240	1.240	1.240	1.240			
				(3) 2.3, 2.3, 2.2, 2.1		1.245	1.250	1.250	1.220			
6	Chev. B. S., USA 0062023	4-H	B	(1) 2.3, 2.3, 2.3, 2.3		1.260	1.260	1.260	1.260			
				(2) 2.3, 2.3, 2.3, 2.3		1.260	1.260	1.260	1.260			
				(3) 2.3, 2.3, 2.3, 2.3		1.250	1.265	1.260	1.265			
7	Chev. B. S., USA 0024390	4-H	B	(1) 2.3, 2.3, 2.3, 2.3		1.270	1.285	1.260	1.265			
				(2) 2. 3, 2.3, 2.3, 2.3		1.270	1.285	1.260	1.265			
				(3) 2.3, 2.3, 2.3, 2.4		1.270	1.285	1.260	1.290			
8	Chev. B. S., USA 004633	4-H	B	(1) 2.3, 2.4, 2.3, 2.3		1.280	1.285	1.260	1.260			
				(2) 2.3, 2.4, 2.3, 2.3		1.280	1.285	1.265	1.260			
				(3) 2.3, 2.4, 2.3, 2.3		1.280	1.285	1.280	1.270			
9	Chev. B. S., USA 0036915	4-H	B	(1) 2.3, 2.3, 2.2		1.240	1.260	1.240	1.265			
				(2) 2.3, 2.3, 2.2		1.240	1.250	1.245	1.265			
				(3) 2.2, 2.2, 2.2		1.220	1.240	1.245	1.265			
10	Chev. B. S., USA 0012194	4-H	B	(1) 2.2, 2.2, 2.1, 2.1		1.210	1.220	1.200	1.200			
				(2) 2.2, 2.2, 2.1, 2.1		1.200	1.220	1.200	1.200			
				(3) 2.2, 2.2, 2.2, 2.2		1.200	1.220	1.220	1.220			
11	Chev. B. S., USA 0036912	4-H	B	(1) 2.3, 2.3, 2.2, 2.2		1.260	1.260	1.240	1.240			
				(2) 2.3, 2.3, 2.2, 2.2		1.260	1.260	1.240	1.240			
				(3) 2.2, 2.2, 2.2, 2.3		1.240	1.250	1.240	1.260			
12	Chev. Dump, USA 3486794	4-H	B	(1) 2.2, 2.2, 2.2, 2.2		1.240	1.250	1.245	1.240			
				(2) 2.2, 2.2, 2.2, 2.2		1.240	1.250	1.245	1.240			
				(3) 2.2, 2.2, 2.2, 2.2		1.230	1.245	1.220	1.220			

13	Chev. B. S., USA 0023356	4–H	C	(1) 2.2, 2.2, 2.2, 2.2		1.200	1.240	1.220	1.200	
				(2) 2.2, 2.2, 2.2, 2.2		1.200	1.240	1.220	1.200	
				(3) 2.2, 2.2, 2.2, 2.2		1.200	1.240	1.230	1.200	
14	Chev. B. S., USA 0037167	4–H	C	(1) 2.2, 2.2, 2.3, 2.4		1.230	1.220	1.285	1.285	
				(2) 2.2, 2.2, 2.3, 2.4		1.230	1.240	1.285	1.285	
				(3) 2.2, 2.2, 2.3, 2.4		1.220	1.220	1.285	1.300	
15	Chev. B. S., USA 0062257	4–H	C	(1) 2.3, 2.3, 2.3, 2.3		1.280	1.270	1.265	1.265	
				(2) 2.3, 2.3, 2.3, 2.3		1.280	1.270	1.265	1.265	
				(3) 2.3, 2.3, 2.3, 2.3		1.280	1.270	1.265	1.265	
16	Chev. Dump, USA 3102711	4–H	C	(1) 2.3, 2.3, 2.3, 2.3		1.240	1.260	1.260	1.265	
				(2) 2.3, 2.3, 2.3, 2.3		1.240	1.260	1.260	1.265	
				(3) 2.2, 2.2, 2.2, 2.3		1.230	1.240	1.240	1.260	
17	Chev. Dump, USA 3486532	2–H	C	(1) 2.3, 2.0, 2.3, 2.3		1.260	1.160	1.260	1.245	
				(2) 2.2, 2.0, 2.3, 2.3		1.240	1.160	1.260	1.245	
				(3) 2.2, 2.0, 2.3, 2.3		1.240	[4] 1.160	1.260	1.245	
18	Ford C, USA 3154673	2–H	C	(1) 2.2, 2.2, 2.3, 2.4		1.230	1.245	1.260	1.280	
				(2) 2.2, 2.2, 2.3, 2.4		1.230	1.245	1.260	1.280	
				(3) 2.2, 2.2, 2.3, 2.4		1.240	1.245	1.265	1.300	
19	Jeep C. & R., USA 20596040	2–H	C	(1) 2.3, 2.3, 2.3, 2.3		1.260	1.280	1.280	1.280	
				(2) 2.3, 2.3, 2.3, 2.3		1.260	1.275	1.280	1.280	
				(3) 2.3, 2.3, 2.3, 2.3		1.280	1.275	1.285	1.285	
20	Chev. P. U., USA 295581	2–H	C	(1) 2.3, 2.3, 2.3, 2.3		1.240	1.260	1.250	1.240	
				(2) 2.3, 2.3, 2.3, 2.3		1.240	1.260	1.250	1.240	
				(3) 2.3, 2.3, 2.3, 2.3		1.240	1.260	1.250	1.240	
21	Ford S. & P., USA 3283846	2–H	C	(1) 2.3, 2.3, 2.3, 2.3		1.260	1.250	1.270	1.265	
				(2) 2.3, 2.3, 2.3, 2.3		1.260	1.250	1.270	1.260	
				(3) 2.3, 2.3, 2.3, 2.3		1.270	1.260	1.280	1.265	
22	Jeep C. & R., USA 20679846	2–H	C	(1) 2.3, 2.3, 2.2, 2.2		1.250	1.265	1.240	1.240	
				(2) 2.3, 2.3, 2.2, 2.2		1.250	1.265	1.240	1.240	
				(3) 2.3, 2.3, 2.3, 2.3		1.260	1.270	1.250	1.250	
23	Jeep C. & R., USA 20153979	2–H	D	(1) 2.3, 2.3, 2.3, 2.3		1.290	1.260	1.275	1.260	
				(2) 2.3, 2.3, 2.3, 2.3		1.270	1.260	1.270	1.260	
				(3) 2.3, 2.3, 2.3, 2.3		1.285	1.270	1.270	1.245	
24	Jeep C. & R., USA 20268509	2–H	D	(1) 2.3, 2.3, 2.3, 2.3		1.250	1.255	1.260	1.260	
				(2) 2.3, 2.3, 2.3, 2.3		1.250	1.255	1.260	1.260	
				(3) 2.3, 2.3, 2.3, 2.3		1.245	1.250	1.260	1.260	
25	Chev. B. S., USA 0023197	2–H	D	(1) 2.0, 2.3, 2.2, 2.3		1.180	1.270	1.240	1.260	
				(2) 2.0, 2.3, 2.2, 2.3		1,180	1.270	1.240	1.260	
				(3) 2.0, 2.3, 2.2, 2.3	[5]	1,180	1.265	1.243	1.250	
26	Chev. P. U., USA 2271226	1–M	D	(1) 2.3, 2.2, 2.2, 2.3		1.260	1.250	1.240	1.260	
				(2) 2.3, 2.2, 2.2, 2.2		1.260	1.250	1.250	1.250	
				(3) 2.3, 2.2, 2.2, 2.2		1.250	1.240	1.240	1.240	
27	Ford P. U., USA 252456	2–H	D	(1) 2.3, 2.3, 2.2, 2.2		1.240	1.260	1.240	1.240	
				(2) 2.3, 2.3, 2.2, 2.2		1.240	1.260	1.240	1.240	
				(3) 2.3, 2.3, 2.3, 2.3		1.240	1.260	1.250	1.245	
28	Chev. B. S., USA 0012034	4–H	D	(1) 2.3, 2.3, 2.3, 2.3		1.280	1.280	1.265	1.260	
				(2) 2.3, 2.2, 2.3, 2.3		1.260	1.280	1.265	1.260	
				(3) 2.3, 2.3, 2.3, 2.3		1.265	1.260	1.265	1.265	

[1] Switch left on, charged May 20, 1949.
[2] Charged May 26, 1949.
[3] Switch left on, charged May 6, 1949.
[4] Switch left on charged May 13, 1949.
[5] Removed from USA 0023405 and charged May 6, 1949.

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
29	Chev. B. S., USA 0037036	4–H	D	(1) 2.2, 2.3, 2.3, 2.3		1.230	1.250	1.265	1.260			
				(2) 2.2, 2.3, 2.3, 2.3		1.230	1.250	1.265	1.260			
				(3) 2.2, 2.3, 2.3, 2.3		1.220	1.250	1.265	1.260			
30	Chev. P. U., USA 297458	1–M	D	(1) 2.2, 2.2, 2.2, 2.3		1.240	1.240	1.240	1.245			
				(2) 2.2, 2.2, 2.2, 2.3		1.240	1.240	1.240	1.245			
				(3) 2.2, 2.2, 2.2, 2.2		1.230	1.230	1.235	1.240			
31	Ford S. & P., USA 3144872	2–H	D	(1) 2.3, 2.3, 2.3, 2.3		1.250	1.265	1.260	1.260			
				(2) 2.3, 2.3, 2.3, 2.3		1.260	1.265	1.260	1.260			
				(3) 2.3, 2.3, 2.3, 2.3		1.260	1.265	1.260	1.260			
32	Chev. P. U., USA 2269937	1–M	D	(1) 2.3		1.260						
				(2) 2.3		1.260						
				(3) 2.3		1.250						
33	Chev. P. U., USA 2270235	1–M	D	(1) 2.3, 2.3, 2.3			1.265	1.265	1.265			
				(2) 2.3, 2.3, 2.3			1.265	1.265	1.265			
				(3) 2.3, 2.3, 2.3			1.265	1.265	1.260			Removed from USA 2269937 and installed in USA 2270235 May 9, 1949.

To: OCO, attn: Field Service Division, Maintenance Branch, Auto Section.
Subject: Letter report on field service test of transport vehicle batteries containing Protecto-Charge.
1. Forwarded is information requested in basic letter, subject as above for month ending June 30, 1949.

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C			1st week	2d week	3d week	4th week	5th week		
1	Int. Bus., USA 20664991	4–H	A	2.2, 2.2, 2.2, 2.2		1.220	1.200	1.220	1.200			
				2.2, 2.2, 2.2, 2.2		1.220	1.220	1.220	1.220			
				2.2, 2.2, 2.2, 2.2		1.240	1.240	1.240	1.240			
2	Int. Bus., USA 20664810	4–H	A	2.2, 2.2, 2.2, 2.2		1.240	1.240	1.240	1.240			
				2.2, 2.2, 2.2, 2.2		1.240	1.240	1.240	1.240			
				2.2, 2.1, 2.2, 2.2		1.220	1.220	1.220	1.220			
3	Jeep C. & R., USA 20766808	2–H	A	2.2, 2.2, 2.2, 2.0		1.220	1.220	1.220	1.240			
				2.2, 2.2, 2.2, 2.0		1.220	1.210	1.220	1.200			
				2.0, 2.0, 2.0, 2.0		1.185	1.185	1.200	1.200			
4	Chev. B. S., USA 0037672	4–H	B	2.2, 2.2, 2.2, 2.0		1.220	1.200	1.200	[1] 1.180			
				2.2, 2.2, 2.2, 2.0		1.200	1.200	1.200	1.180			
				2.2, 2.2, 2.2, 2.0		1.200	1.215	1.200	1.180			
5	Chev. B. S., USA 00243387	4–H	B	2.2, 2.2, 2.2, 2.2		1.220	1.230	1.220	1.220			
				2.2, 2.2, 2.2, 2.2		1.240	1.220	1.220	1.220			
				2.3, 2.2, 2.2, 2.2		1.250	1.220	1.220	1.220			
6	Chev. B. S., USA 0062023	4–H	B	2.3, 2.2, 2.3, 2.3		1.260	1.240	1.260	1.260			
				2.3, 2.2, 2.2, 2.3		1.260	1.240	1.220	1.260			
				2.3, 2.3, 2.2, 2.3		1.265	1.250	1.220	1.260			
7	Chev. B. S., USA 0024390	4–H	B	2.3, 2.3, 2.4, 2.3		1.260	1.260	1.285	1.260			
				2.3, 2.3, 2.4, 2.3		1.260	1.260	1.285	1.260			
				2.3, 2.4, 2.4, 2.3		1.270	1.280	1.285	1.270			
8	Chev. B. S., USA 004633	4–H	B	2.3, 2.3, 2.4, 2.2		1.245	1.260	1.280	1.245			
				2.3, 2.3, 2.4, 2.2		1.245	1.260	1.280	1.245			
				2.3, 2.3, 2.4, 2.2		1.245	1.265	1.280	1.245			
9	Chev. B. S., USA 0036915	4–H	B	2.3, 2.3, 2.3, 2.2		1.240	1.260	1.240	1.200			
				2.3, 2.3, 2.2, 2.2		1.240	1.260	1.220	1.200			
				2.3, 2.3, 2.2, 2.2		1.220	1.260	1.220	1.200			
10	Chev. B. S., USA 0012194	4–H	B	2.2, 2.0, 2.2, 2.2		1.230	[2] 1.160	1.200	1.200			
				2.2, 2.0, 2.2, 2.2		1.240	1.160	1.200	1.200			
				2.2, 2.0, 2.2, 2.2		1.240	1.160	1.200	1.200			
11	Chev. B. S., USA 0036012	4–H	B	2.3, 2.3, 2.2, 2.2		1.260	1.250	1.200	1.220			
				2.3, 2.3, 2.2, 2.2		1.260	1.250	1.200	1.240			
				2.3, 2.3, 2.2, 2.3		1.260	1.265	1.200	1.260			
12	Chev. Dump, USA 3486794	4–H	B	2.3, 2.3, 2.2, 2.2		1.240	1.240	1.220	1.200			
				2.3, 2.3, 2.2, 2.2		1.240	1.240	1.220	1.200			
				2.2, 2.2, 2.3, 2.2		1.220	1.220	1.240	1.220			
13	Chev. B. S., USA 0023356	4–H	C	2.0, 2.4, 2.4, 2.4		[3] 1.180	1.300	1.300	1.300			
				2.0, 2.4, 2.4, 2.4		1.180	1.300	1.300	1.300			
				2.0, 2.4, 2.4, 2.4		1.180	1.300	1.300	1.300			

[1] Battery removed and charged June 30, 1949.

[2] Battery removed and charged June 10, 1949. Switch left on.

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
14	Chev. B. S., USA 0037167	4–H	C	2.4, 2.4, 2.4, 2.3		1.285	1.285	1.300	1.260			
				2.4, 2.4, 2.4, 2.4		1.285	1.285	1.280	1.280			
				2.4, 2.4, 2.4, 2.4		1.285	1.300	1.280	1.300			
15	Chev. B. S., USA 0062257	4–H	C	(1) 2.3, 2.3, 2.3, 2.2		1.240	1.240	1.240	1.220			
				(2) 2.3, 2.3, 2.3, 2.2		1.240	1.240	1.240	1.220			
				(3) 2.3, 2.2, 2.3, 2.3		1.260	1.220	1.240	1.240			
16	Chev. Dump, USA 3102711	4–H	C	(1) 2.3, 2.3, 2.3, 2.3		1.265	1.260	1.240	1.245			
				(2) 2.3, 2.3, 2.3, 2.3		1.260	1.260	1.240	1.245			
				(3) 2.3, 2.3, 2.3, 2.3		1.265	1.265	1.240	1.260			
17	Chev. Dump, USA 3486532	2–H	C	(1) 2.2, 2.3, 2.3, 2.3		1.220	1.240	1.240	1.240			
				(2) 2.3, 2.3, 2.3, 2.3		1.220	1.240	1.245	1.240			
				(3) 2.3, 2.2, 2.2, 2.2		1.240	1.220	1.220	1.220			
18	Ford C, USA 3154673	2–H	C	(1) 2.4, 2.4, 2.0, 2.4		1.280	1.280	[3] 1.160	1.280			
				(2) 2.4, 2.4, 2.0, 2.4		1.280	1.280	1.160	1.280			
				(3) 2.4, 2.4, 2.0, 2.4		1.290	1.290	1.160	1.270			
19	Jeep C. R., USA 20596040	2–H	C	(1) 2.3, 2.3, 2.3, 2.3		1.265	1.260	1.265	1.260			
				(2) 2.3, 2.3, 2.3, 2.3		1.265	1.260	1.265	1.260			
				(3) 2.3, 2.3, 2.3, 2.3		1.265	1.265	1.265	1.260			
20	Chev. P. U., USA 295581	2–H	C	(1) 2.3, 2.3, 2.3, 2.3		1.240	1.240	1.240	1.220			
				(2) 2.3, 2.3, 2.3, 2.3		1.240	1.240	1.240	1.220			
				(3) 2.3, 2.3, 2.3, 2.3		1.240	1.240	1.240	1.220			
21	Ford S. & P., USA 3283846	2–H	C	(1) 2.4, 2.4, 2.4, 2.3		1.280	1.280	1.280	1.260			
				(2) 2.4, 2.4, 2.4, 2.3		1.280	1.280	1.280	1.260			
				(3) 2.3, 2.4, 2.4, 2.3		1.260	1.285	1.280	1.260			
22	Jeep C. R., USA 20679846	2–H	C	(1) 2.3, 2.3, 2.3, 2.3		1.240	1.260	1.245	1.250			
				(2) 2.3, 2.3, 2.3, 2.3		1.240	1.260	1.245	1.250			
				(3) 2.2, 2.2, 2.3, 2.4		1.230	1.240	1.220	1.260			
23	Jeep C. R., USA 20153979	2–H	D	(1) 2.3, 2.3, 2.4, 2.3		1.245	1.260	1.280	1.240			
				(2) 2.3, 2.3, 2.4, 2.3		1.245	1.260	1.280	1.240			
				(3) 2.3, 2.3, 2.4, 2.2		1.260	1.260	1.285	1.220			
24	Jeep C. R., USA 20768509	2–H	D	(1) 2.3, 2.3, 2.3, 2.3		1.260	1.260	1.265	1.260			
				(2) 2.3, 2.3, 2.3, 2.3		1.260	1.260	1.265	1.260			
				(3) 2.4, 2.3, 2.4, 2.3		1.280	1.260	1.265	1.260			
25	Chev. B. S., USA 0023197	2–H	D	(1) 2.2, 2.3, 2.3, 2.3		1.200	1.260	1.245	1.260			
				(2) 2.2, 2.3, 2.3, 2.3		1.200	1.260	1.250	1.260			
				(3) 2.2, 2.3, 2.3, 2.3		1.200	1.240	1.245	1.260			
26	Chev. P. U., USA 2271226	1–M	D	(1) 2.3, 2.0, 2.4, 2.3		1.240	[4] 1.150	1.275	1.265			
				(2) 2.3, 2.0, 2.4, 2.3		1.240	1.150	1.275	1.265			
				(3) 2.2, 2.0, 2.4, 2.3		1.220	1.150	1.280	1.265			

27	Ford P. U., USA 252456	2–H	D	(1) 2.3, 2.3, 2.3, 2.3		1.265	1.240	1.250	1.260	
				(2) 2.3, 2.3, 2.3, 2.3		1.265	1.240	1.250	1.260	
				(3) 2.3, 2.3, 2.3, 2.3		1.260	1.240	1.250	1.270	
28	Chev. B.S., USA 0012034	4–H	D	(1) 2.3, 2.3, 2.2, 2.3		1.260	1.260	1.230	1.245	
				(2) 2.3, 2.3, 2.3, 2.3		1.260	1.260	1.240	1.245	
				(3) 2.3, 2.3, 2.3, 2.3		1.260	1.245	1.260	1.245	
29	Chev. B. S., USA 0037036	4–H	D	(1) 2.2, 2.3, 2.3, 2.2		1.230	1.240	1.260	1.220	
				(2) 2.2, 2.3, 2.3, 2.3		1.230	1.240	1.260	1.220	
				(3) 2.2, 2.2, 2.3, 2.3		1.230	1.220	1.265	1.220	
30	Chev. P. U., USA 297458	1–M	D	(1) 2.3, 2.3, 2.4, 2.3		1.240	1.240	1.270	1.245	
				(2) 2.2, 2.3, 2.4, 2.3		1.240	1.240	1.270	1.245	
				(3) 2.2, 2.3, 2.4, 2.3		1.220	1.245	1.270	1.260	
31	Ford S. & P., USA 3144872	2–H	D	(1) 2.3, 2.3, 2.3, 2.3		1.240	1.260	1.260	1.250	
				(2) 2.3, 2.3, 2.3, 2.3		1.240	1.260	1.260	1.250	
				(3) 2.3, 2.3, 2.3, 2.3		1.240	1.260	1.260	1.250	
32	Chev. P. U., USA 2270235	1–M	D	(1) 2.3, 2.3, 2.4, 2.4		1.265	1.265	1.270	1.280	
				(2) 2.3, 2.3, 2.4, 2.4		1.265	1.265	1.270	1.280	
				(3) 2.3, 2.4, 2.4, 2.4		1.260	1.270	1.270	1.270	

[1] Battery charged June 17, 1949. B. O. Lights left on.

[4] Battery charged June 10, 1949. Switch left on.

To: OCO, attn: Field Service Division, Maint Br, Auto Sect.
Subject: Letter report on Field Service Test of Transport Vehicle Batteries containing Protecto-Charge.
1. Forwarded is information requested in basic letter, subject as above for month ending July 29, 1949.

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C			1st week	2d week	3d week	4th week	5th week		
1	Int. Bus., USA 20664991	4–H	A	(1) 2.3, 2.3, 2.3, 2.2		1.250	1.240	1.240	1.240		July 29, 1949	Generator: July 2, 1932. See note 1.
				(2) 2.3, 2.3, 2.3, 2.3		1.250	1.240	1.250	1.240			
				(3) 2.3, 2.2, 2.3, 2.2		1.240	1.230	1.240	1.230			
2	Int. Bus., USA 20664810	4–H	A	(1) 2.3, 2.3, 2.3, 2.2		1.250	1.260	1.250	1.240		July 29, 1949	July 2, 1932. See note 2.
				(2) 2.2, 2.3, 2.3, 2.2		1.240	1.250	1.250	1.240			
				(3) 2.2, 2.2, 2.2, 2.2		1.240	1.240	1.240	1.230			
3	Jeep C. & R., USA 20766808	2–H	A	(1) 1+		1.160					July 3, 1949	July 5, 1940. See note 3.
				(2) 1+		1.150	(1)	(1)	(1)			
				(3) 2.0		1.200						
4	Chev. B. S., USA 0037672	4–H	B	(1) 2.4, 2.4, 2.3, 2.4		1.280	1.280	1.260	1.280		July 29, 1949	July 5, 1940. See note 4.
				(2) 2.4, 2.4, 2.3, 2.4		1.280	1.280	1.260	1.280			
				(3) 2.3, 2.3, 2.3, 2.4		1.260	1.270	1.250	1.260			
5	Chev. B. S., USA 00243387	4–H	B	(1) 2.3, 2.3, 2.2, 2.2		1.250	1.250	1.240	1.230		July 29, 1949	July 5, 1940. See note 5.
				(2) 2.3, 2.2, 2.2, 2.2		1.250	1.240	1.240	1.230			
				(3) 2.2, 2.3, 2.2, 2.2		1.240	1.240	1.250	1.220			
6	Chev. B. S., USA 0062023	4–H	B	(1) 2.3, 2.4, 2.4, 2.3		1.250	1.260	1.260	1.240		July 29, 1949	July 5, 1940. See note 6.
				(2) 2.3, 2.4, 2.4, 2.3		1.250	1.260	1.260	1.240			
				(3) 2.3, 2.4, 2.4, 2.3		1.250	1.260	1.260	1.240			
7	Chev. B. S., USA 0024390	4–H	B	(1) 2.3, 2.3, 2.3, 2.4		1.250	1.260	1.260	1.270		July 29, 1949	July 5, 1940. See note 7.
				(3) 2.3, 2.3, 2.3, 2.4		1.250	1.260	1.260	1.270			
				(3) 2.3, 2.3, 2.3, 2.4		1.250	1.270	1.270	1.280			
8	Chev. B. S. USA 004638	4–H	B	(1) 2.3, 2.3, 2.3, 2.3		1.260	1.270	1.260	1.260		July 29, 1949	July 5, 1940. See note 8.
				(2) 2.3, 2.3, 2.3, 2.3		1.260	1.270	1.260	1.260			
				(3) 2.3, 2.3, 2.3, 2.3		1.260	1.270	1.260	1.265			
9	Chev. B. S., USA 0036915	4–H	B	(1) 2.2, 2.3, 2.2, 2.2		1.240	1.260	1.250	1.240		July 29, 1949	July 5, 1940. See note 9.
				(2) 2.2, 2.2, 2.2, 2.2		1.230	1.250	1.240	1.220			
				(3) 2.2, 2.2, 2.2, 2.2		1.220	1.250	1.240	1.220			
10	Chev. B. S., USA 0012194	4–H	B	(1) 2.3, 2.3, 2.2, 2.2		1.250	1.250	1.250	1.220		July 29, 1949	July 5, 1940. See note 10.
				(2) 2.3, 2.3, 2.3, 2.2		1.250	1.250	1.250	1.220			
				(3) 2.3, 2.3, 2.3, 2.2		1.240	1.245	1.240	1.220			
11	Chev. B. S., USA 0036912	4–H	B	(1) 2.3, 2.4, 2.4, 2.3		1.250	1.265	1.270	1.260		July 29, 1949	July 5, 1940. See note 11.
				(2) 2.3, 2.4, 2.4, 2.4		1.260	1.270	1.275	1.270			
				(3) 2.3, 2.4, 2.4, 2.4		1.260	1.270	1.275	1.270			
12	Chev. Dump, USA 3486794	4–H	B	(1) 2.3, 2.3, 2.3, 2.3		1.260	1.250	1.260	1.245		July 29, 1949	July 5, 1940. See note 12.
				(2) 2.3, 2.3, 2.3, 2.3		1.260	1.250	1.260	1.245			
				(3) 2.3, 2.3, 2.3, 2.3		1.255	1.245	1.250	1.235			

13	Chev. B. S., USA 0023356	4–H	C	(1) 2.4, 2.4, 2.4, 2.4		1.300	1.290	1.280	1.300	July 29, 1949	July 5, 1940. See note 13.
				(2) 2.4, 2.4, 2.4, 2.4		1.300	1.290	1.280	1.300		
				(3) 2.4, 2.4, 2.4, 2.4		1.300	1.290	1.280	1.300		
14	Chev. B. S., USA 0037167	4–H	C	(1) 2.3, 2.4, 2.4, 2.3		1.250	1.260	1.260	1.245	July 29, 1949	July 5, 1950. See note 14.
				(2) 2.3, 2.3, 2.4, 2.3		1.250	1.260	1.260	1.245		
				(3) 2.3, 2.3, 2.3, 2.3		1.245	1.260	1.255	1.240		
15	Chev. B. S., USA 0062257	4–H	C	(1) 2.2, 2.2, 2.2, 2.2		1.240	1.240	1.240	1.220	July 29, 1949	July 5, 1940. See note 15.
				(2) 2.2, 2.2, 2.2, 2.2		1.240	1.240	1.240	1.220		
				(3) 2.2, 2.2, 2.2, 2.0		1.235	1.235	1.230	1.200		
16	Chev. Dump, USA 3102711	4–H	C	(1) 2.4, 2.3, 2.3, 2.3		1.270	1.265	1.260	1.260	Aug. 1, 1949	July 5, 1940. See note 16.
				(2) 2.3, 2.3, 2.3, 2.3		1.270	1.260	1.260	1.260		
				(3) 2.3, 2.3, 2.3, 2.3		1.260	1.250	1.250	1.240		
17	Chev. Dump, USA 3486532	2–H	C	(1) 2.3, 2.4, 2.3, 2.3		1.250	1.270	1.260	1.260	Aug. 1, 1949	July 5, 1940. See note 17.
				(2) 2.3, 2.4, 2.3, 2.3		1.250	1.270	1.260	1.260		
				(3) 2.3, 2.3, 2.3, 2.3		1.240	1.265	1.250	1.245		
18	Ford C, USA 3154673	2–H	C	(1) 2.2, 2.2, 2.2, 2.2		1.250	1.2.0	1.230	1.2.0	July 29, 1949	July 2, 1933. See note 18.
				(2) 2.2, 2.2, 2.2, 2.2		1.255	1.240	1.240	1.240		
				(3) 2.2, 2.2, 2.2, 2.2		1.250	1.240	1.240	1.240		
19	Jeep C. & R., USA 20596040	2–H	C	(1) 2.3, 2.4, 2.3, 2.3		1.260	1.275	1.260	1.260	Aug. 1, 1949	July 5, 1940. See note 19.
				(2) 2.3, 2.4, 2.3, 2.3		1.260	1.275	1.260	1.260		
				(3) 2.3, 2.4, 2.3, 2.3		1.260	1.275	1.260	1.260		
20	Chev. P. U., USA 295581	2–H	C	(1) 2.4, 2.3, 2.3, 2.2		1.260	1.260	1.240	1.220	Aug. 1, 1949	July 3, 1933. See note 20.
				(2) 2.4, 2.3, 2.3, 2.2		1.260	1.260	1.240	1.220		
				(3) 2.4, 2.3, 2.3, 2.2		1.165	1.250	1.245	1.230		
21	Ford S. & P., USA 3283846	2–H	C	(1) 2.3, 2.3, 2.3, 2.0		1.250	1.250	1.245	1.180	July 29, 1949	July 2, 1933. See note 21.
				(2) 2.3, 2.3, 2.3, 2.0		1.250	1.250	1.245	1.180		Failed. Switch left on.
				(3) 2.3, 2.3, 2.3, 2.0		1.150	1.245	1.245	1.180		Recharged to 1.260 all cells prior to breakdown.
22	Jeep C. & R., USA 20679846	2–H	C	(1) 2.3, 2.3, 2.3, 2.3		1.250	1.260	1.260	1.240	Aug. 1, 1949	July 5, 1940. See note 22.
				(2) 2.3, 2.3, 2.3, 2.2		1.250	1.260	1.260	1.240		
				(3) 2.3, 2.3, 2.3, 2.2		1.240	1.250	1.250	1.220		
23	Jeep C. & R., USA 20153979	2–H	D	(1) 2.3, 2.3, 2.3, 2.3		1.250	1.270	1.260	1.260	Aug. 1, 1949	July 5, 1940. See note 23.
				(2) 2.3, 2.3, 2.3, 2.3		1.250	1.265	1.260	1.260		
				(3) 2.3, 2.3, 2.3, 2.3		1.245	1.260	1.250	1.240		
24	Jeep C. & R., USA 20768509	2–H	D	(1) 2.4, 2.3, 2.4, 2.3		1.250	1.250	1.260	1.240	Aug. 1, 1949	July 5, 1940. See note 24.
				(2) 2.4, 2.3, 2.4, 2.3		1.260	1.250	1.260	1.240		
				(3) 2.4, 2.3, 2.4, 2.3		1.260	1.250	1.260	1.240		
25	Chev. B. S., USA 0023197	2–H	D	(1) 2.3, 2.3, 2.3, 2.3		1.260	1.260	1.250	1.240	July 29, 1949	July 5, 1940. See note 25.
				(2) 2.3, 2.3, 2.3, 2.3		1.260	1.260	1.250	1.240		
				(3) 2.3, 2.3, 2.3, 2.2		1.250	1.255	1.245	1.230		
26	Chev. P. U., USA 2271226	1–M	D	(1) 2.3, 2.3, 2.3, 2.3		1.260	1.250	1.265	1.260	July 29, 1949	July 3, 1932. See note 26.
				(2) 2.3, 2.3, 2.3, 2.3		1.255	1.250	1.265	1.260		
				(3) 2.3, 2.3, 2.3, 2.3		1.260	1.250	1.265	1.260		
27	Ford P. U., USA 252456	2–H	D	(1) 2.2, 2.2, 2.2, 2.0		1.240	1.250	1.220	1.185	July 29, 1949	July 3, 1930. See note 27.
				(2) 2.2, 2.2, 2.2, 2.2		1.250	1.255	1.230	1.200		
				(3) 2.2, 2.2, 2.2, 2.2		1.250	1.250	1.230	1.200		
28	Chev. B. S., USA 0012034	4–H	D	(1) 2.3, 2.3, 2.3, 2.3		1.260	1.250	1.260	1.260	Aug. 1, 1949	July 5, 1940. See note 28.
				(2) 2.3, 2.3, 2.3, 2.3		1.260	1.255	1.260	1.265		
				(3) 2.3, 2.3, 2.3, 2.3		1.260	1.250	1.260	1.260		

[1] Failed July 3.

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
29	Chev. B. S., USA 0037036	4–H	D	(1) 2.3, 2.3, 2.3, 2.3		1.250	1.260	1.250	1.240		July 29, 1949	July 5, 1940. See note 29.
				(2) 2.2, 2.3, 2.3, 2.2		1.250	1.260	1.250	1.240			
				(3) 2.2, 2.3, 2.2, 2.2		1.240	1.255	1.240	1.230			
30	Chev. P. U., USA 297458	1–M	D	(1) 2.3, 2.3, 2.3, 2.3		1.250	1.250	1.260	1.260		July 29, 1949	July 2, 1932. See note 30.
				(2) 2.2, 2.3, 2.3, 2.3		1.240	1.245	1.250	1.240			
				(3) 2.2, 2.2, 2.2, 2.2		1.230	1.230	1.230	1.220			
31	Ford S. & P., USA 3144872	2–H	D	(1) 2.2, 2.3, 2.2, 2.2		1.240	1.260	1.240	1.220		Aug. 1, 1949	July 2, 1930. See note 31.
				(2) 2.2, 2.3, 2.2, 2.2		1.240	1.260	1.245	1.220			
				(3) 2.2, 2.3, 2.2, 2.3		1.240	1.255	1.240	1.220			
32	Chev. P. U., USA 2270235	1–M	D	(1) 2.3, 2.3, 2.3, 2.3		1.260	1.240	1.260	1.260		Aug. 1, 1949	July 2, 1933. See note 32.
				(2) 2.3, 2.3, 2.3, 2.3		1.255	1.245	1.260	1.260			
				(3) 2.3, 2.3, 2.3, 2.3		1.260	1.240	1.260	1.260			

Cell sludge measured in 1-quart jars.

NOTE No. 1: (1) ¼-inch.
(2) ¼-inch. Separators rotten, plates perforated, 120 amp per 1 minute, 4.0 volts, wood separator.
(3) 5/16-inch.

NOTE No. 2: (1) ¼-inch. Negative plates puffed.
(2) 5/16-inch. Positive plates good. 130 amp per 1 minute at 4.0 volts. Rubber separator.
(3) ¼-inch. Separators rotten.

NOTE No. 3. (1) ¼ inch. Negative plates scaly.
(2) ¼-inch. Plates perforated. No breakdown test. Wood separator.
(3) 5/16 inch. Separators rotten.

NOTE No. 4: (1) 5/16 inch.
(2) 5/16 inch. Separators sulfated. 300 amps, 1 minute, 4.25 volts. Wood separator.
(3) 3/32 inch.

NOTE No. 5: (1) ¼ inch. Positive grid rotten.
(2) 5/16 inch. Negative good. 200 amps, 2 minutes, 4.0 volts. Wood separators.
(3) ¼ inch.

NOTE No. 6: (1) 1/32 inch. Plates buckled.
(2) 5/16 inch. Positive grid rotten. 200 apms, 2 minutes, 4.5 volts. Rubber separators
(3) 5/16 inch.

NOTE No. 7: (1) 5/16 inch. Negative plates puffed.
(2) 5/16 inch. Positive grid rotten. 300 amps, 1 minute, 4.5 volts. Rubber separators.
(3) 5/16 inch.

NOTE No. 8: (1) 1/32 inch. Negative pulling away from grid.
(2) 1/32 inch. Positive good. 300 amps, 2 minutes, 4.5 volts. Rubber separator.
(3) 5/64 inch. Separators good.

NOTE No. 9: (1) 1/8 inch. Negative scaly.
(2) 1/8 inch. Separators rotten. 100 amps, 1 minute, 4.25 volts. Rubber separator.
(3) 1/16 inch.

NOTE No. 10: (1) 5/16 inch. Negative puffed.
(2) 5/16 inch. Positive cracked. 300 amps, 3 minutes, 4.5 volts. Wood separator.
(3) 5/16 inch.

NOTE No. 11: (1) 1/16-inch. Negative plates puffed.
(2) 1/8-inch. Positive grid rotten. 300 amps, 2 minutes, 4.5 volts. Wood separators.
(3) 3/32-inch. Separators good.

NOTE No. 12: (1) 5/16-inch. Plates buckled.
(2) 5/16-inch. Separators rotten. 200 amps, 2 minutes, 4.5 volts. Wood separators.
(3) 5/16-inch.

NOTE No. 13: (1) 1/8-inch. Negative plates scaley.
(2) 1/16-inch. Positive grid buckeled. 300 amps, 4 minutes, 4.5 volts. Wood separators.
(3) 1/16-inch. Separators good.

NOTE No. 14: (1) 1/64-inch. Separators rotten and sulfated. 200 amps, 2 minutes, 4.25 volts. Wood separators.
(2) 1/32-inch.
(3) 1/64-inch.

NOTE No. 15: (1) 1/32-inch. Negative puffed.
(2) 1/32-inch. Separator rotten. 75 amps, 1 minute, 4.0 volts. Rubber separators.
(3) 1/16-inch. Positive grid rotten.

NOTE No. 16: (1) 1/32-inch. Internal condition good. 250 amps, 2 minutes, 4.2 volts. Rubber separators.
(2) 1/64-inch.
(3) 1/64-inch.

NOTE No. 17: (1) 1/8-inch. Negative plates puffed.
(2) 1/16-inch. Positive good. 150 amps, 1 minute, 4.0 volts. Wood separators.
(3) 1/16-inch. Sulfated.

NOTE No. 18: (1) 1/32 inch. Negative plates crystal sulfate.
(2) 1/32 inch. Separators poor. 300 amps, 2 minutes, 4.5 volts. Wood separators.
(3) 1/64 inch. Plates shorting.

NOTE No. 19: (1) 1/32 inch.
(2) 1/32 inch. Internal condition good. 300 amps, 2 minutes, 4.5 volts. Rubber separators.
(3) 1/64 inch.

NOTE No. 20: (1) 1/32 inch. Negative plates puffed and scaley.
(2) 1/16 inch. Positive grid disintegrated. 200 amps, 1 minute, 4 volts. Wood separators.
(3) 1/32 inch. Separators rotten.

NOTE No. 21: (1) 1/32 inch. Negative plates sulfated.
(2) 1/64 inch. Positive good. 300 amps, 2 minutes, 4.25 volts. Rubber separators.
(3) 1/64 inch.

NOTE No. 22: (1) 1/64 inch. Internal condition good. 200 amps, 1 minute, 4.25 volts. Rubber separators.
(2) 1/32 inch.
(3) 1/64 inch.

NOTE No. 23 :(1) 1/64 inch.
(2) 1/64 inch. Internal condition good. 300 amps, 2 minutes, 4.25 volts. Rubber separators.
(3) 1/64 inch.

NOTE No. 24: (1) 1/64 inch.
(2) 1/64 inch. Internal condition good. 300 amps, 2 minutes, 4.25 volts. Rubber separators.
(3) 1/64 inch.

NOTE No. 25: (1) 1/8 inch. Negative plates puffed.
(2) 1/32 inch. Positive plates cracked. 75 amp, 1 minute, 4.0 volts. Wood separators.
(3) 1/64 inch. Separators rotten.

NOTE No. 26: (1) 1/64 inch. Negative plates scaley.
(2) 1/64 inch. Positive plates cracked. Wood separators.
(3) 1/64 inch. Separators rotten.

NOTE No. 27: (1) 1/32 inch. Negative plates good.
(2) 1/32 inch. Positive grid disintegrating. 100 amps, 1 minute, 4.0 volts. Rubber separators.
(3) 1/64 inch. Separators good.

NOTE No. 28: (1) 1/64 inch. Negative plates sulfated.
(2) 1/64 inch. Positive plates separating from grid. 300 amps, 2 minutes, 4.25 volts. Wood separators.
(3) 1/32 inch.

NOTE No. 29: (1) 1/64 inch. Negative plates separating from grid.
(2) 1/64 inch. Some sulfation. 300 amps, 1 minutes, 4.25 volts. Wood separators.
(3) 1/64 inch.

NOTE No. 30: (1) 1/32 inch. Negative plates scaling.
(2) 1/32 inch. Positive plates trace of sulfate. 100 amps, 1 minute, 4.0 volts. Wood separators.
(3) 1/64 inch. Separators rotten.

NOTE No. 31: (1) 1/64 inch.
(2) 1/64 inch. Internal condition good. 300 amps, 3 minutes, 4.25 volts. Rubber separators.
(3) 1/32 inch.

NOTE No. 32: (1) 1/64 inch. Negative plates shedding.
(2) 1/64 inch. Separators rotten. 200 amps, 1 minute, 4.2 volts. Wood separators.
(3) 1/64 inch. Positive grid disintegrating.

HEADQUARTERS BENICIA ARSENAL,
OFFICE OF THE COMMANDING OFFICER,
Benicia, Calif., January 6, 1949.

Subject: Letter report on field service test of transport vehicle batteries containing Protecto-Charge.
To: Chief of Ordnance, Department of the Army, Washington 25, D. C.
(Attention ORDFM-Auto.)

Reference letter from your office dated October 22, 1948, subject as above, file O. O. 412.4/925, letter report for month of December 1948 attached.

For the Commanding Officer:

D. A. KLEIN,
Captain, Ordnance Department, Assistant.

1 enclosure, Ltr Report.

Line No.	Vehicle nomenclature and United States Registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
1	W/C, BA–761, USA 277006	2–H	A	(1)								Battery No. 1 removed from service, failed to take charge.
2	W/C, BA–782, USA 2168006	2–H	A	(1) 2.3, 2.3, 2.2, 2.3		1.280	1.285	1.276	1.286			
				(2) 2.3, 2.3, 2.2, 2.3		1.290	1.290	1.276	1.286			
				(3) 2.3, 2.3, 2.2, 2.3		1.290	1.290	1.276	1.296			
3	W/C, BA–777, USA 2175648	2–H	A	(1) 2.2, 2.2, 2.1, 2.1		1.250	1.250	1.248	1.228			
				(2) 2.2, 2.2, 2.1, 2.1		1.260	1.270	1.268	1.248			
				(3) 2.2, 2.2, 2.1, 2.1		1.250	1.260	1.248	1.238			
4	W/C, BA–784, USA 2162897	2–H	A	(1)								Battery No. 4 removed from service, failed to take charge.
5	W/C, BA–759, USA 2120106	2–H	A	(1) 2.2, 2.1, 2.3, 2.2		1.240	1.250	1.242	1.256			
				(2) 2.2, 2.1, 2.3, 2.2		1.250	1.270	1.262	1.266			
				(3) 2.2, 2.1, 2.3, 2.2		1.270	1.260	1.242	1.246			
6	W/C, BA–773, USA 2161747	2–H	A	(1) 2.3, 2.2, 2.3, 2.2		1.280	1.280	1.172	1.260			
				(2) 2.3, 2.2, 2.3, 2.2		1.270	1.270	1.182	1.255			
				(3) 2.3, 2.2, 2.3, 2.2		1.250	1.270	1.242	1.270			
7	W/C, BA–760, USA 2113601	2–H	A	(1)								Reported off test last report.
8	W/C, BA–756, USA 274336	2–H	A	(1)								Battery No. 8 on charge for 1½ weeks. Would not retain charge.
9	W/C, BA–780, USA 2303475	2–H	A	(1)								Removed from test, broken plate.
10	W/C, BA–776, USA 2168328	2–H	A	(1) 2.3, 2.0, 2.1, 2.2		1.290	1.140	1.230	1.256			
				(2) 2.3, 2.0, 2.1, 2.2		1.290	1.140	1.230	1.246			
				(3) 2.3, 2.1, 2.1, 2.2		1.290	1.155	1.240	1.266			
11	Jeep, BA–154, USA 20607439	2–H	B	(1) 2.3, 2.3, 2.3, 2.3		1.260	1.265	1.262	1.258			
				(2) 2.3, 2.3, 2.3, 2.3		1.280	1.280	1.252	1.268			
				(3) 2.3, 2.3, 2.3, 2.3		1.260	1.265	1.262	1.268			
12	Jeep, BA–181, USA 20300313	2–H	B	(1) 2.3, 2.3, 2.4		1.290	1.290		1.300			Battery No. 12 on charge 3d week.
				(2) 2.3, 2.3, 2.3		1.285	1.290		1.300			
				(3) 2.3, 2.3, 2.4		1.290	1.300		1.300			
13	Jeep, BA–177, USA 20594739	2–H	B	(1) 2.2, 2.2, 2.1, 2.3		1.220	1.270	1.250	1.260			
				(2) 2.3, 2.2, 2.1, 2.3		1.270	1.270	1.200	1.250			
				(3) 2.2, 2.1, 2.1, 2.2		1.260	1.220	1.210	1.210			
14	Jeep, BA–126, USA 2036750	2–H	B	(1) 2.2, 2.0, 2.2, 2.1		1.230	1.230	1.225	1.210			
				(2) 2.2, 2.1, 2.2, 2.1		1.250	1.250	1.240	1.220			
				(3) 2.2, 2.0, 2.2, 2.1		1.230	1.230	1.220	1.200			
15	Jeep, BA–164, USA 20767294	2–H	B	(1) 2.2, 2.3, 2.3, 2.3		1.250	1.250	1.252	1.290			
				(2) 2.2, 2.3, 2.3, 2.3		1.240	1.250	1.242	1.290			
				(3) 2.2, 2.3, 2.3, 2.3		1.240	1.245	1.242	1.290			
16	Jeep, BA–101, USA 20124002	2–H	B	(1) 2.2, 2.2, 2.1		1.240	1.250	1.192				Battery No. 16 on charge 4th week.
				(2) 2.2, 2.2, 2.1		1.240	1.250	1.192				
				(3) 2.2, 2.2, 2.1		1.240	1.260	1.202				

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
17	Jeep, BA–153, USA 20658409	2–H	B	(1) 2.2, 2.3, 2.3, 2.4		1.280	1.300	1.292	1.300			
				(2) 2.2, 2.3, 2.3, 2.4		1.270	1.300	1.292	1.300			
				(3) 2.2, 2.3, 2.3, 2.4		1.280	1.300	1.292	1.300			
18	Jeep, BA–141, USA 20371253	2–H	B	(1) 2.1, 2.2, 2.2, 2.1		1.230	1.250	1.260	1.235			
				(2) 2.1, 2.2, 2.2, 2.1		1.230	1.250	1.260	1.240			
				(3) 2.1, 2.2, 2.2, 2.1		1.230	1.250	1.260	1.235			
19	Jeep, BA–133, USA 20300615	2–H	B	(1) 2.1, 2.2, 2.3, 2.2		1.270	1.280	1.270	1.280			
				(2) 2.1, 2.2, 2.3, 2.3		1.280	1.280	1.270	1.280			
				(3) 2.1, 2.2, 2.3, 2.3		1.280	1.270	1.270	1.290			
20	Jeep, BA–182, USA 20158854	2–H	B	(1)								Battery No. 20 failed test.
21	W/C, BA–723, USA 288922	2–H	C	(1) 2.2, 2.3, 2.3, 2.3		1.275	1.270	1.264	1.262			
				(2) 2.2, 2.3, 2.3, 2.3		1.280	1.270	1.264	1.262			
				(3) 2.2, 2.3, 2.3, 2.3		1.285	1.280	1.274	1.262			
22	W/C, BA–755, USA 280460	2–H	C	(1) 2.3, 2.3, 2.3, 2.3		1.300	1.290	1.294	1.292			
				(2) 2.3, 2.3, 2.3, 2.3		1.290	1.280	1.284	1.282			
				(3) 2.3, 2.3, 2.3, 2.3		1.300	1.290	1.294	1.282			
23	W/C, BA–727, USA 20118998	2–H	C	(1) 2.3, 2.3, 2.4, 2.4		1.300	1.300	1.299	1.294			
				(2) 2.3, 2.3, 2.4, 2.4		1.300	1.300	1.299	1.284			
				(3) 2.3, 2.3, 2.4, 2.4		1.300	1.300	1.299	1.294			
24	W/C, BA–732, USA 2116271	2–H	C	(1) 2.3, 2.3, 2.2, 2.3		1.290	1.290	1.287	1.234			
				(2) 2.3, 2.3, 2.1, 2.3		1.300	1.290	1.287	1.264			
				(3) 2.3, 2.3, 2.1, 2.3		1.280	1.290	1.277	1.234			
25	W/C, BA–785, USA 2166964	2–H	C	(1) 2.3, 2.1, 2.3, 2.5		1.290	1.270	1.286	1.290			
				(2) 2.3, 2.1, 2.3, 2.3		1.290	1.230	1.276	1.285			
				(3) 2.3, 2.1, 2.3, 2.3		1.290	1.245	1.286	1.300			
26	W/C, BA–734, USA 285116	2–H	C	(1) 2.2, 2.1, 2.3, 2.3		1.290	1.180	1.266	1.244			
				(2) 2.3, 2.1, 2.3, 2.3		1.280	1.170	1.256	1.264			
				(3) 2.3, 2.1, 2.3, 2.3		1.290	1.185	1.266	1.274			
27	W/C, BA–725, USA 20120029	2–H	C	(1) 2.2, 2.3, 2.2, 2.2		1.280	1.280	1.274	1.210			
				(2) 2.2, 2.3, 2.2, 2.2		1.280	1.285	1.279	1.260			
				(3) 2.3, 2.3, 2.3, 2.2		1.280	1.280	1.279	1.260			
28	W/C, BA–730, USA 252330	2–H	C	(1) 2.1, 2.2, 2.2, 2.3		1.250	1.265	1.277	1.228			
				(2) 2.1, 2.2, 2.3, 2.3		1.260	1.265	1.267	1.248			
				(3) 2.1, 2.2, 2.2, 2.3		1.250	1.265	1.277	1.238			
29	W/C, BA–724, USA 276307	2–H	C	(1) 2.2, 2.2, 2.3, 2.3		1.240	1.270	1.262	1.272			
				(2) 2.2, 2.2, 2.2, 2.3		1.240	1.270	1.252	1.262			
				(3) 2.2, 2.2, 2.3, 2.3		1.240	1.270	1.262	1.262			
30	W/C, BA–720, USA 275732	2–H	C	(1) 2.3, 2.3, 2.2, 2.3		1.280	1.300	1.300	1.290			
				(2) 2.2, 2.3, 2.2, 2.3		1.270	1.300	1.290	1.280			
				(3) 2.2, 2.2, 2.2, 2.3		1.260	1.280	1.280	1.280			

31	Jeep, BA-151, USA 20366993.	2-H	D	(1) 2.4, 2.2, 2.3, 2.3		1.300	1.260	1.290	1.286	
				(2) 2.4, 2.2, 2.3, 2.3		1.300	1.260	1.300	1.296	
				(3) 2.3, 2.2, 2.3, 2.3		1.290	1.260	1.290	1.286	
32	Jeep, BA-165, USA 20766772.	2-H	D	(1) 2.1, 2.0, 2.2, 2.2		1.250	1.220	1.240	1.210	
				(2) 2.1, 2.1, 2.2, 2.2		1.260	1.240	1.240	1.210	
				(3) 2.1, 2.0, 2.2, 2.2		1.240	1.230	1.240	1.210	
33	Jeep, BA-119, USA 20368472.	2-H	D	(1) 2.2, 2.3, 2.1, 2.2		1.280	1.280	1.257	1.250	
				(2) 2.2, 2.3, 2.1, 2.3		1.280	1.280	1.257	1.250	
				(3) 2.3, 2.3, 2.1, 2.3		1.300	1.280	1.262	1.270	
34	Jeep, BA-150, USA 2047347.	2-H	D	(1) 2.2, 2.1, 2.2, 2.2		1.280	1.260	1.280	1.266	
				(2) 2.2, 2.1, 2.2, 2.2		1.290	1.260	1.280	1.266	
				(3) 2.2, 2.1, 2.2, 2.2		1.280	1.260	1.280	1.266	
35	Jeep, BA-162, USA 20619543.	2-H	D	(1) 2.2, 2.1, 2.1, 2.3		1.290	1.275	1.277	1.266	
				(2) 2.2, 2.1, 2.1, 2.3		1.280	1.280	1.267	1.256	
				(3) 2.2, 2.1, 2.1, 2.3		1.285	1.280	1.277	1.256	
36	Jeep, BA-136, USA 20300482.	2-H	D	(1) 2.1, 2.3, 2.4, 2.4		1.270	1.280	1.268	1.270	
				(2) 2.1, 2.3, 2.4, 2.4		1.270	1.280	1.278	1.270	
				(3) 2.1, 2.3, 2.4, 2.4		1.270	1.270	1.268	1.270	
37	Jeep, BA-156, USA 20670098	2-H	D	(1) 2.2, 2.1, 2.2, 2.2		1.270	1.230	1.270	1.250	
				(2) 2.2, 2.1, 2.2, 2.2		1.270	1.230	1.265	1.245	
				(3) 2.2, 2.1, 2.2, 2.2		1.270	1.240	1.270	1.250	
38	Jeep, BA-118, USA 2039220	2-H	D	(1) 2.3, 2.3, 2.3, 2.2		1.270	1.290	1.270	1.240	
				(2) 2.2, 2.3, 2.3, 2.2		1.280	1.270	1.280	1.250	
				(3) 2.2, 2.3, 2.3, 2.2		1.270	1.260	1.270	1.245	
39	Jeep, BA-132, USA 20307497	2-H	D	(1) 2.2, 2.3, 2.1, 2.2		1.290	1.270	1.209	1.260	
				(2) 2.2, 2.3, 2.1, 2.2		1.300	1.290	1.209	1.270	
				(3) 2.2, 2.3, 2.1, 2.2		1.300	1.290	1.209	1.280	
40	Jeep, BA-169, USA 20767152	2-H	D	(1) 2.3, 2.1, 2.2, 2.1		1.280	1.280	1.270	1.254	
				(2) 2.3, 2.1, 2.2, 2.1		1.280	1.280	1.270	1.254	
				(3) 2.3, 2.1, 2.2, 2.1		1.275	1.280	1.270	1.254	

HEADQUARTERS, BENICIA ARSENAL,
OFFICE OF THE COMMANDING OFFICER,
Benicia, Calif., February 9, 1949.

Subject: Letter report on field service test of transport vehicle batteries containing Protecto-Charge.
To: Chief of Ordnance, Department of the Army, Washington 25, D. C.
(Attention ORDFM-Auto.)

Reference letter from your office dated October 22, 1948, subject as above, file O. O. 412.4/925, letter report for month of January 1949 attached.

For the Commanding Officer:
1 Incl., Ltr Report.

WALDO B. BERRYMAN, Jr.,
Major, Ordnance Department, Assistant.

Line No.	Vehicle nomenclature and United States registry No.	Battery type: Standard nomenclature	Battery type: Type, A, B, C, D	Voltage reading from test	Number of times battery received charge this month	Specific gravity: 1st week	2d week	3d week	4th week	5th week	Date battery was removed	Remarks
1	W/C, BA-761 USA 277606	2-H	A								Dec. 31, 1948	Failure.
2	W/C, BA-782 USA 2168006	2-H	A	(1) 2.3, 2.2, 2.7, 2.2		1.265	Dry	1.270	1.280			
				(2) 2.3, 2.2, 2.2, 2.2		1.270	Dry	1.270	1.280			
				(3) 2.3, 2.2, 2.2, 2.2		1.270	1.300	1.280	1.290			
3	W/C, BA-777 USA 2175648	2-H	A	(1) 2.2, 2.2, 2.2, 2.1		1.280	1.260	1.260	1.235			
				(2) 2.2, 2.2, 2.2, 2.1		1.280	1.260	1.260	1.235			
				(3) 2.2, 2.2, 2.2, 2.1		1.280	1.270	1.260	1.220			
4	W/C, BA-784 USA 2162897	2-H	A								Dec. 31, 1948	Do.
5	W/C, BA-759 USA 2120106	2-H	A	(1) 2.3, 2.2, 2.2, 2.2		1.250	1.270	1.250	1.250			
				(2) 2.3, 2.2, 2.3, 2.2		1.270	1.290	1.270	1.270			
				(3) 2.3, 2.2, 2.2, 2.2		1.250	1.270	1.250	1.250			
6	W/C, BA-773 USA 2161747	2-H	A	(1) 2.3, 2.2, 2.2, 2.2		1.255	1.275	1.280	1.250			
				(2) 2.3, 2.2, 2.2, 2.2		1.255	1.270	1.280	1.270			
				(3) 2.3, 2.2, 2.2, 2.2		1.265	1.290	1.290	1.250			
7	W/C, BA-750 USA 2113601	2-H	A								Dec. 31, 1948	Do.
8	W/C, BA-756 USA 274336	2-H	A								do	Do.
9	W/C, BA-780, USA 2303475	2-H	A								Dec. 31, 1948	Do.
10	W/C, BA-776, USA 2168328	2-H	A	(1) 2.1, 2.1, 2.2, 2.2		1.210	1.260	1.260	1.280			
				(2) 2.1, 2.1, 2.2, 2.2		1.200	1.260	1.260	1.280			
				(3) 2.1, 2.1, 2.2, 2.2		1.210	1.260	1.270	1.300			
11	Jeep, BA-154, USA 20697439	2-H	B	(1) 2.3, 2.3, 2.3, 2.3		1.270	1.280	1.260	1.270			
				(2) 2.3, 2.3, 2.3, 2.3		1.270	1.280	1.270	1.280			
				(3) 2.3, 2.3, 2.3, 2.3		1.260	1.290	1.260	1.270			
12	Jeep, BA-181, USA 20309313	2-H	B	(1) 2.4, 2.4, 2.3, 2.3		1.300	1.300	1.280	1.300			
				(2) 2.4, 2.4, 2.3, 2.3		1.300	1.310	1.280	1.300			
				(3) 2.4, 2.4, 2.3, 2.3		1.300	1.300	1.290	1.300			
13	Jeep, BA-177, USA 20594739	2-H	B	(1) 2.3, 2.3, 2.3, 2.3		1.260	1.300	1.280	1.275			
				(2) 2.3, 2.3, 2.3, 2.3		1.270	1.280	1.270	1.280			
				(3) 2.3, 2.3, 2.3, 2.4		1.260	1.300	1.290	1.300			
14	Jeep, BA-126, USA 2036750	2-H	B	(1) 2.1, 2.3, 2.3, 2.2		1.230	1.240	1.230	1.220			
				(2) 2.1, 2.3, 2.3, 2.3		1.240	1.260	1.250	1.240			
				(2) 2.2, 2.3, 2.3, 2.2		1.230	1.250	1.240	1.230			
15	Jeep, BA-164, USA 20767294	2-H	B	(1) 2.3, 2.3, 2.3, 2.2		1.250	1.260	1.270	1.250			
				(2) 2.3, 2.3, 2.3, 2.2		1.250	1.260	1.250	1.260			
				(3) 2.3, 2.3, 2.3, 2.2		1.240	1.250	1.250	1.250			
16	Jeep, BA-101, USA 20124062	2-H	B	(1) 2.2, 2.3, 2.2, 2.3		1.290	1.290	1.270	1.280			
				(2) 2.2, 2.3, 2.2, 2.3		1.270	1.290	1.270	1.270			
				(3) 2.2, 2.3, 2.2, 2.2		1.270	1.290	1.270	1.260			
17	Jeep, BA-153, USA 20658409	2-H	B	(1) 2.3, 2.3, 2.3, 2.3		1.300	1.290	1.300	1.280			
				(2) 2.3, 2.3, 2.3, 2.3		1.300	1.290	1.300	1.280			
				(3) 2.3, 2.3, 2.3, 2.3		1.300	1.290	1.290	1.280			

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
18	Jeep, BA-141 USA 20371253	2-H	B	(1) 2.2, 2.2, 2.1, 2.2		1.260	1.280	1.240	1.260			Failure.
				(2) 2.2, 2.2, 2.1, 2.2		1.260	1.270	1.250	1.270			
				(3) 2.2, 2.2, 2.1, 2.2		1.250	1.270	1.240	1.260			
19	Jeep, BA-133 USA 20300615	2-H	B	(1) 2.2, 2.2, 2.3, 2.3		1.270	1.290	1.275	1.290			
				(2) 2.2, 2.2, 2.3, 2.3		1.280	1.290	1.275	1.280			
				(3) 2.2, 2.2, 2.3, 2.3		1.260	1.285	1.270	1.280			
20	Jeep, BA-182 USA 20158854	2-H	B								Dec. 31, 1948	Do.
21	W/C, BA-723 USA 288922	2-H	C	(1) 2.3, 2.3, 2.3, 2.2		1.270	1.280	1.290	1.250			
				(2) 2.3, 2.3, 2.3, 2.2		1.270	1.290	1.290	1.260			
				(3) 2.3, 2.3, 2.3, 2.2		1.280	1.290	1.290	1.260			
22	W/C, BA-755 USA 280460	2-H	C	(1) 2.3, 2.3, 2.3, 2.3		1.300	1.300	1.290	1.290			
				(2) 2.3, 2.3, 2.3, 2.3		1.300	1.280	1.290	1.290			
				(3) 2.3, 2.3, 2.3, 2.3		1.290	1.295	1.290	1.290			
23	W/C, BA-727 USA 20120029	2-H	C	(1) 2.3, 2.4, 2.3, 2.3		1.300	1.300	1.290	1.290			
				(2) 2.2, 2.3, 2.3, 2.3		1.270	1.285	1.280	1.300			
				(3) 2.3, 2.3, 2.3, 2.3		1.290	1.290	1.290	1.290			
24	W/C, BA-732 USA 2116271	2-H	C	(1) 2.2, 2.2, 2.2, 2.1		1.275	1.275	1.260	1.250			
				(2) 2.2, 2.2, 2.2, 2.1		1.280	1.280	1.270	1.250			
				(3) 2.2, 2.2, 2.2, 2.1		1.260	1.265	1.260	1.230			
25	W/C, BA-785 USA 2166964	2-H	C	(1) 2.2, 2.4, 2.3, 2.3		1.280	1.300	1.295	1.285			
				(2) 2.2, 2.4, 2.3, 2.3		1.280	1.305	1.300	1.285			
				(3) 2.2, 2.4, 2.3, 2.3		1.290	1.300	1.300	1.285			
26	W/C, BA-734 USA 285116	2-H	C	(1) 2.2, 2.2, 2.3, 2.2		1.270	1.270	1.290	1.255			
				(2) 2.2, 2.2, 2.3, 2.2		1.270	1.280	1.290	1.260			
				(3) 2.2, 2.2, 2.3, 2.2		1.290	1.280	1.280	1.260			
27	W/C, BA-725, USA 20120029	2-H	C	(1) 2.1, 2.2, 2.2, 2.2		1.260	1.260	1.270	1.280			
				(2) 2.1, 2.2, 2.2, 2.2		1.270	1.280	1.280	1.280			
				(3) 2.1, 2.2, 2.2, 2.2		1.270	1.270	1.280	1.280			
28	W/C, BA-730, USA 252330	2-H	C	(1) 2.1, 2.1, 2.1, 2.3		1.270	1.275	1.270	1.290			
				(2) 2.1, 2.1, 2.1, 2.3		1.270	1.270	1.275	1.290			
				(3) 2.1, 2.1, 2.1, 2.3		1.270	1.270	1.270	1.290			
29	W/C, BA-724, USA 276307	2-H	C	(1) 2.3, 2.3, 2.3, 2.3		1.270	1.270	1.280	1.280			
				(2) 2.3, 2.3, 2.3, 2.3		1.270	1.265	1.270	1.270			
				(3) 2.3, 2.3, 2.3, 2.3		1.270	1.270	1.280	1.270			
30	W/C, BA-729, USA 275732	2-H	C	(1) 2.3, 2.2, 2.3, 2.3		1.270	1.285	1.290	1.300			
				(2) 2.3, 2.1, 2.3, 2.3		1.270	1.265	1.280	1.300			
				(3) 2.3, 2.1, 2.3, 2.3		1.270	1.260	1.275	1.300			
31	Jeep, BA-151, USA 20369993	2-H	D	(1) 2.4, 2.4, 2.3, 2.3		1.300	1.295	1.290	1.270			
				(2) 2.4, 2.4, 2.3, 2.3		1.300	1.295	1.300	1.280			
				(3) 2.4, 2.4, 2.3, 2.3		1.300	1.295	1.290	1.280			

32	Jeep, BA–165, USA 20766772	2–H	D	(1) 2.1, 2.0, 2.1, 2.2		1.215	1.180	1.260	1.280		Battery down due to switch being left on. Not removed.
				(2) 2.1, 2.0, 2.1, 2.2		1.220	1.170	1.270	1.290		
				(3) 2.1, 2.0, 2.1, 2.2		1.215	1.170	1.260	1.280		
33	Jeep, BA–119, USA 20368472	2–H	D	(1) 2.2, 2.2, 2.3, 2.1		1.250	1.260	1.270	1.250		
				(2) 2.2, 2.2, 2.3, 2.1		1.250	1.260	1.270	1.250		
				(3) 2.3, 2.3, 2.3, 2.1		1.270	1.270	1.280	1.265		
34	Jeep, BA–150, USA 2047347	2–H	D	(1) 2.2, 2.3, 2.3, 2.2		1.275	1.285	1.280	1.250		
				(2) 2.2, 2.3, 2.3, 2.2		1.275	1.285	1.280	1.250		
				(3) 2.2, 2.3, 2.3, 2.2		1.275	1.285	1.280	1.250		
35	Jeep, BA–162, USA 20619543	2–H	D	(1) 2.2, 2.2, 2.2, 2.1		1.270	1.270	1.270	1.250		
				(2) 2.2, 2.2, 2.2, 2.1		1.275	1.260	1.260	1.240		
				(3) 2.2, 2.2, 2.2, 2.1		1.265	1.270	1.260	1.250		
36	Jeep, BA–136 USA 20300482	2–H	D	(1) 2.3, 2.3, 2.3, 2.3		1.280	1.275	1.280	1.280		
				(2) 2.3, 2.3, 2.3, 2.3		1.280	1.280	1.290	1.280		
				(3) 2.3, 2.3, 2.3, 2.3		1.270	1.275	1.280	1.270		
37	Jeep, BA–156 USA 20670098	2–H	D	(1) 2.2, 2.2, 2.2, 2.2		1.265	1.260	1.270	1.250		
				(2) 2.2, 2.2, 2.2, 2.2		1.260	1.260	1.270	1.250		
				(3) 2.2, 2.2, 2.2, 2.2		1.265	1.260	1.270	1.250		
38	Jeep, BA–118 USA 2039220	2–H	D	(1) 2.2, 2.2, 2.3, 2.2		1.260	1.260	1.270	1.250		
				(2) 2.2, 2.2, 2.3, 2.2		1.260	1.260	1.270	1.260		
				(3) 2.2, 2.2, 2.3, 2.2		1.260	1.260	1.270	1.250		
39	Jeep, BA–132 USA 20307497	2–H	D	(1) 2.2, 2.4, 2.4, 2.1		1.260	1.300	1.290	1.185		Down 4th week due to short in stop light Left in Oper.
				(2) 2.2, 2.4, 2.4, 2.1		1.260	1.300	1.300	1.185		
				(3) 2.2, 2.4, 2.4, 2.1		1.260	1.300	1.300	1.190		
40	Jeep, BA–169 USA 20767152	2–H	D	(1) 2.1, 2.2, 2.2, 2.3		1.250	1.270	1.280	1.300		
				(2) 2.1, 2.2, 2.2, 2.3		1.250	1.270	1.280	1.300		
				(3) 2.1, 2.2, 2.2, 2.3		1.250	1.270	1.280	1.300		

HEADQUARTERS, BENICIA ARSENAL,
OFFICE OF THE COMMANDING OFFICER,
Benicia, Calif., March 3, 1949.

Subject: Letter Report on Field Service Test of Transport Vehicle Batteries Containing Protecto-Charge.
To: Chief of Ordnance, Department of the Army, Washington 25, D. C.
(Attention: ORDFM-Auto.)

Reference letter from your office dated 22 October 1948, subject as above, file 0.0. 412.4/925. Letter report for month of February 1949 attached.

For the Commanding Officer:

WALDO B. BERRYMAN, Jr.,
Major, Ordnance Department, Assistant.

1 enclosure, letter report for February 1949.

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
1	W/C, BA–761, USA 277606	2–H	A								Dec. 31, 1948	Failure.
2	W/C, BA–782, USA 2168000	2–H	A	(1) 2.2, 2.2, 2.2, 2.2, 2.2	0	1.275	1.280	1.280	1.275	1.260		
				(2) 2.2, 2.2, 2.2, 2.2, 2.2	0	1.275	1.280	1.290	1.280	1.260		
				(3) 2.2, 2.2, 2.2, 2.2, 2.2	0	1.290	1.290	1.290	1.290	1.270		
3	W/C, BA–777, USA 2175648	2–H	A	(1) 2.3, 2.2, 2.2, 2.3, 2.1	0	1.250	1.240	1.260	1.250	1.255		
				(2) 2.3, 2.2, 2.2, 2.3, 2.1		1.250	1.240	1.260	1.255	1.260		
				(3) 2.3, 2.2, 2.2, 2.3, 2.1		1.250	1.240	1.260	1.250	1.255		
4	W/C, BA–784, USA 2162897	2–H	A								Dec. 31, 1948	Do.
5	W/C, BA–759, USA 2120106	2–H	A	(1) 2.3, 2.1, 2.1, 2.1, 2.1	0	1.250	1.220	1.260	1.250	1.230		
				(2) 2.3, 2.1, 2.1, 2.1, 2.1		1.260	1.230	1.270	1.260	1.240		
				(3) 2.3, 2.1, 2.1, 2.1, 2.1	0	1.250	1.220	1.260	1.240	1.230		
6	W/C, BA–773, USA 2161747	2–H	A	(1) 2.3, 2.3, 2.3, 2.2, 2.3	0	1.270	1.270	1.270	1.250	1.275		
				(2) 2.3, 2.3, 2.3, 2.2, 2.3		1.270	1.270	1.270	1.260	1.275		
				(3) 2.3, 2.3, 2.3, 2.2, 2.3		1.270	1.280	1.280	1.270	1.290		
7	W/C, BA–750, USA 2113601	2–H	A								Dec. 31, 1948	Do.
8	W/C, BA–756, USA 274336	2–H	A								....do....	Do.
9	W/C, BA–780, USA 2303475	2–H	A								....do....	Do.
10	W/C, BA–776, USA 2168328	2–H	A	(1) 2.3, 2.2, 2.2, 2.2, 2.2	0	1.280	1.275	1.270	1.260	1.275		
				(2) 2.3, 2.2, 2.2, 2.2, 2.2		1.280	1.275	1.270	1.260	1.275		
				(3) 2.3, 2.2, 2.2, 2.2, 2.2		1.290	1.275	1.280	1.260	1.280		
11	Jeep, BA–184, USA 20697439	2–H	B	(1) 2.3, 2.3, 2.2, 2.1, 2.3	0	1.280	1.270	1.260	1.250	1.240		
				(2) 2.3, 2.3, 2.2, 2.1, 2.3		1.280	1.275	1.270	1.260	1.260		
				(3) 2.3, 2.3, 2.2, 2.1, 2.3		1.280	1.275	1.260	1.260	1.260		
12	Jeep, BA–181, USA 20309313	2–H	B	(1) 2.4, 2.3, 2.3, 2.3, 2.3	0	1.300	1.290	1.280	1.280	1.300		
				(2) 2.4, 2.3, 2.3, 2.3, 2.3		1.300	1.290	1.290	1.290	1.300		
				(3) 2.4, 2.3, 2.3, 2.3, 2.3		1.300	1.300	1.300	1.290	1.300		
13	Jeep, BA–177, USA 20594739	2–H	B	(1) 2.3, 2.3, 2.3, 2.2, 2.3	0	1.300	1.270	1.270	1.280	1.280		
				(2) 2.3, 2.3, 2.3, 2.2, 2.3		1.290	1.260	1.280	1.280	1.275		
				(3) 2.3, 2.3, 2.3, 2.2, 2.3		1.300	1.280	1.270	1.290	1.290		
14	Jeep, BA–126, USA 2036750	2–H	B	(1) 2.3, 2.3, 2.3, 2.2, 2.2	0	1.220	1.240	1.240	1.220	1.215		
				(2) 2.2, 2.3, 2.3, 2.2, 2.2		1.250	1.250	1.250	1.240	1.235		
				(3) 2.2, 2.3, 2.3, 2.2, 2.2		1.230	1.240	1.240	1.220	1.220		
15	Jeep, BA–164, USA 20767294	2–H	B	(1) 2.3, 2.3, 2.3, 2.2, 2.3	0	1.250	1.250	1.250	1.230	1.240		
				(2) 2.3, 2.3, 2.3, 2.2, 2.3		1.250	1.250	1.260	1.230	1.240		
				(3) 2.3, 2.3, 2.3, 2.2, 2.3		1.250	1.250	1.250	1.230	1.240		
16	Jeep, BA–101, USA 20124062	2–H	B	(1) 2.2, 2.2, 2.1, 2.2, 2.3	0	1.280	1.280	1.270	1.260	1.270		
				(2) 2.2, 2.2, 2.1, 2.2, 2.3		1.270	1.280	1.270	1.260	1.270		
				(3) 2.2, 2.2, 2.1, 2.2, 2.3		1.260	1.280	1.260	1.260	1.255		

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
17	Jeep, BA–153, USA 20658409	2–H	B	(1) 2.2, 2.3, 2.3, 2.3, 2.3	0	1.270	1.290	1.300	1.300	1.290		
				(2) 2.3, 2.3, 2.3, 2.3, 2.3		1.270	1.280	1.300	1.300	1.290		
				(3) 2.2, 2.3, 2.3, 2.3, 2.3		1.270	1.290	1.290	1.300	1.280		
18	Jeep, BA–141, USA 20371253.	2–H	B	(1) 2.2, 2.3, 2.1, 2.1, 2.1	0	1.260	1.270	1.270	1.240	1.260		
				(2) 2.2, 2.3, 2.1, 2.1, 2.1		1.270	1.280	1.270	1.240	1.255		
				(3) 2.2, 2.3, 2.1, 2.1, 2.1		1.260	1.270	1.260	1.240	1.260		
19	Jeep, BA–133, USA 20300615.	2–H	B	(1) 2.3, 2.3, 2.3, 2.2, 2.2	0	1.280	1.280	1.280	1.270	2.265		
				(2) 2.3, 2.3, 2.3, 2.2, 2.2		1.280	1.280	1.280	1.280	1.270		
				(3) 2.3, 2.3, 2.3, 2.2, 2.2		1.280	1.280	1.270	1.270	1.265		
20	Jeep, BA–182, USA 20158854.	2–H	B								Dec. 31, 1948	Do.
21	W/C, BA–723, USA 288922.	2–H	C	(1) 2.3, 2.3, 2.3, 2.3, 2.3	0	1.290	1.280	1.280	1.270	1.275		
				(2) 2.3, 2.3, 2.3, 2.3, 2.3		1.290	1.290	1.290	1.280	1.280		
				(3) 2.3, 2.3, 2.3, 2.3, 2.3		1.290	1.290	1.290	1.290	1.280		
22	W/C, BA–755, USA 280460	2–H	C	(1) 2.2, 2.2, 2.2, 2.2, 2.1	0	1.270	1.260	1.260	1.240	1.250		
				(2) 2.3, 2.2, 2.2, 2.1, 2.1		1.270	1.260	1.250	1.230	1.230		
				(3) 2.2, 2.2, 2.2, 2.1, 2.1		1.270	1.270	1.260	1.240	1.230		
23	W/C, BA–727, USA 20118998.	2–H	C	(1) 2.3, 2.3, 2.3, 2.2, 2.2	0	1.280	1.290	1.300	1.290	1.290		
				(2) 2.3, 2.3, 2.3, 2.2, 2.2		1.275	1.270	1.280	1.270	1.270		
				(3) 2.3, 2.3, 2.3, 2.2, 2.2		1.270	1.280	1.290	1.280	1.280		
24	W/C, BA–732, USA 2116271	2–H	C	(1) 2.2, 2.3, 2.3, 2.1, 2.2	0	1.270	1.280	1.275	1.260	1.260		
				(2) 2.2, 2.3, 2.3, 2.1, 2.2		1.270	1.275	1.280	1.260	1.265		
				(3) 2.2, 2.3, 2.3, 2.1, 2.2		1.270	1.280	1.270	1.250	1.260		
25	W/C, BA–785, USA 2166964	2–H	C	(1) 2.4, 2.3, 2.3, 2.2, 2.2	0	1.290	1.270	1.280	1.290	1.280		
				(2) 2.4, 2.3, 2.3, 2.2, 2.2		1.300	1.280	1.300	1.290	1.280		
				(3) 2.4, 2.3, 2.3, 2.2, 2.2		1.300	1.290	1.300	1.300	1.290		
26	W/C, BA–734, USA 285116	2–H	C	(1) 2.2, 2.2, 2.2, 2.3, 2.2	0	1.270	1.260	1.270	1.260	1.260		
				(2) 2.2, 2.2, 2.2, 2.3, 2.2		1.270	1.270	1.270	1.260	1.260		
				(3) 2.2, 2.2, 2.2, 2.3, 2.3		1.280	1.270	1.270	1.270	1.270		
27	W/C, BA–725, USA 20120029	2–H	C	(1) 2.3, 2.3, 2.3, 2.3, 2.3	0	1.290	1.290	1.300	1.280	1.280		
				(2) 2.3, 2.3, 2.3, 2.3, 2.3		1.300	1.290	1.300	1.280	1.280		
				(3) 2.3, 2.3, 2.3, 2.3, 2.3		1.300	1.290	1.290	1.290	1.290		
28	W/C, BA–730, USA 252330	2–H	C	(1) 2.3, 2.3, 2.3, 2.3, 2.3	0	1.275	1.270	1.280	1.280	1.275		
				(2) 2.3, 2.3, 2.3, 2.3, 2.3		1.280	1.275	1.280	1.280	1.280		
				(3) 2.3, 2.3, 2.3, 2.3, 2.3		1.270	1.275	1.280	1.280	1.280		
29	W/C, BA–724, USA 276307	2–H	C	(1) 2.2, 2.2, 2.3, 2.3, 2.2	1	1.275	1.260	1.270	1.300	1.290	Feb. 14, 1949	Replaced Feb. 18, 1949. Ignition left on.
				(2) 2.2, 2.2, 2.3, 2.3, 2.2		1.275	1.260	1.270	1.290	1.290		
				(3) 2.2, 2.2, 2.3, 2.3, 2.2		1.275	1.270	1.270	1.290	1.280		
30	W/C, BA–729, USA 275732	2–H	C	(1) 2.3, 2.3, 2.3, 2.1, 2.2	1	1.300	1.260	1.290	1.240	1.280	Feb. 23, 1949	Replaced Feb. 25, 1949. Faulty starter switch.
				(2) 2.3, 2.3, 2.3, 2.1, 2.2		1.300	1.280	1.290	1.250	1.280		
				(3) 2.3, 2.3, 2.3, 2.1, 2.2		1.300	1.270	1.280	1.240	1.280		

31	Jeep, BA–151, USA 20369993	2–H	D	(1) 2.3, 2.3, 2.3, 2.1, 2.3	0	1.290	1.280	1.280	1.290	1.285	
				(2) 2.3, 2.3, 2.3, 2.1, 2.3		1.300	1.285	1.280	1.300	1.290	
				(3) 2.3, 2.3, 2.3, 2.1, 2.3		1.290	1.280	1.280	1.290	1.285	
32	Jeep, BA–165, USA 20766772	2–H	D	(1) 2.0, 2.0, 2.0, 2.1, 2.1	0	1.180	1.160	1.160	1.170	1.200	
				(2) 2.0, 2.0, 2.0, 2.1, 2.1		1.200	1.165	1.150	1.180	1.215	
				(3) 2.0, 2.0, 2.0, 2.1, 2.1		1.180	1.160	1.140	1.170	1.200	
33	Jeep, BA–119, USA 20368472	2–H	D	(1) 2.3, 2.2, 2.2, 2.2, 2.2	0	1.260	1.250	1.250	1.240	1.250	
				(2) 2.3, 2.2, 2.2, 2.2, 2.2		1.260	1.250	1.250	1.245	1.250	
				(3) 2.3, 2.2, 2.2, 2.2, 2.2		1.260	1.260	1.260	1.255	1.260	
34	Jeep, BA–150, USA 2047347	2–H	D	(1) 2.3, 2.2, 2.2, 2.2, 2.2	0	1.270	1.270	1.270	1.260	1.270	
				(2) 2.3, 2.2, 2.2, 2.2, 2.2		1.270	1.270	1.260	1.260	1.270	
				(3) 2.3, 2.2, 2.2, 2.2, 2.2		1.275	1.270	1.270	1.260	1.270	
35	Jeep, BA–162, USA 20619543	2–H	D	(1) 2.2, 2.2, 2.3, 2.3, 2.2	0	1.250	1.260	1.270	1.270	1.260	
				(2) 2.2, 2.2, 2.3, 2.3, 2.2		1.260	1.250	1.260	1.260	1.250	
				(3) 2.2, 2.2, 2.3, 2.3, 2.2		1.250	1.260	1.270	1.270	1.260	
36	Jeep, BA–136, USA 20300482	2–H	D	(1) 2.4, 2.4, 2.3, 2.4, 2.3	0	1.280	1.270	1.300	1.300	1.280	
				(2) 2.4, 2.4, 2.3, 2.4, 2.3		1.290	1.280	1.300	1.300	1.290	
				(3) 2.4, 2.4, 2.3, 2.4, 2.3		1.290	1.270	1.300	1.300	1.280	
37	Jeep, BA–156, USA 20760098	2–H	D	(1) 2.3, 2.2, 2.3, 2.2, 2.2	0	1.275	Dry	1.270	1.275	1.275	
				(2) 2.3, 2.2, 2.3, 2.2, 2.2		1.280	1.260	1.275	1.275	1.275	
				(3) 2.3, 2.2, 2.3, 2.2, 2.2		1.285	1.240	1.275	1.275	1.275	
38	Jeep, BA–118, USA 2039220	2–H	D	(1) 2.3, 2.3, 2.2, 2.3, 2.3	0	1.260	1.265	1.240	1.260	1.260	
				(2) 2.3, 2.3, 2.2, 2.3, 2.3		1.260	1.270	1.240	1.260	1.260	
				(3) 2.3, 2.3, 2.2, 2.3, 2.3		1.260	1.265	1.230	1.260	1.250	
39	Jeep, BA–132, USA 20307497	2–H	D	(1) 2.3, 2.4, 2.3, 2.3, 2.3	0	1.260	1.290	1.280	1.290	1.290	
				(2) 2.3, 2.4, 2.3, 2.3, 2.3		1.260	1.290	1.290	1.290	1.290	
				(3) 2.3, 2.4, 2.3, 2.3, 2.3		1.280	1.290	1.290	1.290	1.290	
40	Jeep, BA–169, USA 20767152	2–H	D	(1) 2.3, 2.2, 2.2, 2.0, 2.2	0	1.290	1.290	1.290	1.250	1.270	
				(2) 2.3, 2.2, 2.2, 2.0, 2.2		1.290	1.290	1.290	1.240	1.270	
				(3) 2.3, 2.2, 2.2, 2.0, 2.2		1.290	1.290	1.290	1.250	1.270	

HEADQUARTERS, BENICIA ARSENAL,
OFFICE OF THE COMMANDING OFFICER,
Benicia, Calif., April 7, 1949.

Subject: Letter report on field service test of transport vehicle batteries containing Protecto-Charge.
To: Chief of Ordnance, Department of the Army, Washington 25, D. C.
(Attention: ORDFM-Auto.)

Reference letter from your office dated October 22, 1948, subject as above, file O. O. 412.4/925, letter report for month of March 1949 attached hereto.

For the commanding officer:

WALDO B. BERRYMAN, Jr.,
Major, Ordnance Department, Assistant.

1 enclosure, letter report for March 1949.

Line No.	Vehicle nomenclature and United States registry No.	Battery type: Standard nomenclature	Battery type: Type, A, B, C, D	Voltage reading from test	Number of times battery received charge this month	Specific gravity: 1st week	2d week	3d week	4th week	5th week	Date battery was removed	Remarks
1	W/C, BA–761, USA 277606	2–H	A	(1)							Dec. 31, 1948	Failure.
2	W/C, BA–782, USA 2178006	2–H	A	(1) 2.3, 2.3, 2.2, 2.2	0	1.260	1.280	1.280	1.270			
				(2) 2.3, 2.3, 2.2, 2.2		1.280	1.280	1.285	1.270			
				(3) 2.3, 2.3, 2.2, 2.2		1.280	1.290	1.290	1.280			
3	W/C, BA–777, USA 2175648	2–H	A	(1) 2.2, 2.2, 2.1, 2.2	0	1.255	1.250	1.260	1.240			
				(2) 2.2, 2.2, 2.1, 2.2		1.255	1.250	1.270	1.240			
				(3) 2.2, 2.1, 2.1, 2.2		1.240	1.230	1.260	1.240			
4	W/C, BA–784, USA 2152897	2–H	A	(1)							Dec. 31, 1948	Do.
5	W/C, BA–759, USA 2120106	2–H	A	(1) 2.0, 2.2, 2.0, 2.0	0	1.230	1.235	1.250	1.240			
				(2) 2.0, 2.2, 2.0, 2.0		1.240	1.240	1.255	1.250			
				(3) 2.0, 2.2, 2.0, 2.0		1.230	1.235	1.240	1.240			
6	W/C, BA–773, USA 2161747	2–H	A	(1) 2.2, 2.3, 2.2, 2.2	0	1.250	1.265	1.270	1.275			
				(2) 2.2, 2.3, 2.2, 2.2		1.250	1.270	1.275	1.275			
				(3) 2.2, 2.3, 2.2, 2.2		1.240	1.270	1.270	1.280			
7	W/C, BA–750, USA 2113601	2–H	A	(1)							Dec. 31, 1948	Do.
8	W/C, BA–756, USA 274336	2–H	A	(1)							do	Do.
9	W/C, BA–780, USA 2303475	2–H	A	(1)							do	Do.
10	W/C, BA–776, USA 2168328	2–H	A	(1) 2.2, 2.2, 2.2, 2.2	0	1.270	1.270	1.270	1.270			
				(2) 2.2, 2.2, 2.2, 2.2		1.260	1.270	1.270	1.265			
				(3) 2.2, 2.2, 2.2, 2.2		1.270	1.270	1.275	1.265			
11	Jeep, BA–154, USA 20697439	2–H	B	(1) 2.0, 2.2, 2.3, 2.2	0	1.250	1.245	1.250	1.260			
				(2) 2.0, 2.2, 2.3, 2.2		1.270	1.275	1.260	1.260			
				(3) 2.0, 2.2, 2.3, 2.2		1.260	1.265	1.270	1.260			
12	Jeep, BA–181, USA 20300313	2–H	B	(1) 2.3, 2.3, 2.3, 2.3	0	1.285	1.270	1.285	1.285			
				(2) 2.3, 2.3, 2.3, 2.3		1.295	1.280	1.295	1.290			
				(3) 2.3, 2.3, 2.3, 2.3		1.300	1.290	1.300	1.300			
13	Jeep, BA–177, USA 20594739	2–H	B	(1) 2.0, 2.2, 2.3, 2.3	0	1.150	1.260	1.290	1.250			Battery down due to switch being left on all night.
				(2) 2.0, 2.2, 2.3, 2.3		1.140	1.255	1.280	1.280			
				(3) 2.0, 2.2, 2.3, 2.3		1.160	1.260	1.300	1.290			
14	Jeep, BA–126, USA 2036750	2–H	B	(1) 2.2, 2.2, 2.2, 2.2	0	1.215	1.215	1.220	1.260			
				(2) 2.2, 2.2, 2.2, 2.2		1.240	1.240	1.240	1.240			
				(3) 2.2, 2.2, 2.2, 2.2		1.220	1.230	1.230	1.230			
15	Jeep, BA–164, USA 20767294	2–H	B	(1) 2.0, 2.3, 2.3, 2.2	1	1.215	1.280	Dry	1.260		Mar. 9, 1949	Machine in shop for repairs. Battery run down testing engine. Replaced Mar. 16, 1949.
				(2) 2.0, 2.3, 2.3, 2.2		1.215	1.285	Dry	1.250			
				(3) 2.0, 2.3, 2.3, 2.2		1.215	1.280	Dry	1.230			
16	Jeep, BA–101, USA 20124062	2–H	B	(1) 2.2, 2.2, 2.1, 2.2	0	1.270	1.260	1.250	1.260			
				(2) 2.2, 2.2, 2.1, 2.2		1.260	1.250	1.240	1.250			
				(3) 2.2, 2.2, 2.1, 2.2		1.250	1.240	1.230	1.240			

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
17	Jeep, BA–153, USA 20658409	2–H	B	(1) 2.3, 2.3, 2.3, 2.3	0	1.300	Dry	1.300	1.290			
				(2) 2.3, 2.3, 2.3, 2.3		1.300	Dry	1.300	1.295			
				(3) 2.3, 2.3, 2.3, 2.3		1.300	Dry	1.295	1.260			
18	Jeep, BA–141, USA 20321253	2–H	B	(1) 2.2, 2.2, 2.2, 2.2	0	1.270	1.260	1.270	1.260			
				(2) 2.2, 2.2, 2.2, 2.2		1.275	1.270	1.280	1.275			
				(3) 2.2, 2.2, 2.2, 2.2		1.270	1.260	1.270	1.270			
19	Jeep, BA–133, USA 20300615	2–H	B	(1) 2.2, 2.2, 2.2, 2.2	0	1.270	1.270	1.260	1.280			
				(2) 2.2, 2.2, 2.2, 2.2		1.275	1.275	1.270	1.280			
				(3) 2.2, 2.2, 2.2, 2.2		1.265	1.260	1.260	1.250			
20	Jeep, BA–182, USA 20158854	2–H	B	(1)								
21	W/C, BA–723, USA 288922	2–H	C	(1) 2.3, 2.3, 2.2, 2.3	0	1.275	1.275	1.275	1.280		Dec. 31, 1948	Failure.
				(2) 2.3, 2.3, 2.2, 2.3		1.275	1.280	1.280	1.280			
				(3) 2.3, 2.3, 2.2, 2.3		1.275	1.275	1.280	1.290			
22	W/C, BA–755, USA 280460	2–H	C	(1) 2.3, 2.3, 2.2, 2.3	0	1.260	1.280	1.280	1.290			
				(2) 2.3, 2.3, 2.2, 2.3		1.260	1.260	1.270	1.275			
				(3) 2.3, 2.3, 2.2, 2.3		1.240	1.260	1.275	1.300			
23	W/C, BA–727, USA 20118998	2–H	C	(1) 2.3, 2.3, 2.3, 2.3	0	1.300	1.300	1.300	1.300			
				(2) 2.3, 2.3, 2.3, 2.3		1.280	1.280	1.285	1.280			
				(3) 2.3, 2.3, 2.3, 2.3		1.290	1.290	1.285	1.295			
24	W/C, BA–732, USA 2116271	2–H	C	(1) 2.3, 2.3, 2.2, 2.1	0	1.260	1.260	1.275	1.270			
				(2) 2.3, 2.3, 2.2, 2.1		1.270	1.260	1.275	1.270			
				(3) 2.3, 2.3, 2.2, 2.1		1.260	1.260	1.270	1.265			
25	W/C, BA–785, USA 2116964	2–H	C	(1) 2.3, 2.3, 2.3, 2.3	0	1.275	1.280	1.280	1.285			
				(2) 2.3, 2.3, 2.3, 2.3		1.275	1.270	1.280	1.280			
				(3) 2.3, 2.3, 2.3, 2.3		1.280	1.290	1.280	1.300			
26	W/C, BA–734, USA 285116	2–H	C	(1) 2.3, 2.2, 2.2, 2.2	0	1.270	1.260	1.260	1.270			
				(2) 2.3, 2.2, 2.2, 2.2		1.270	1.270	1.260	1.265			
				(3) 2.3, 2.2, 2.3, 2.2		1.270	1.270	1.270	1.280			
27	W/C, BA–725 USA 20120029	2–H	C	(1) 2.2, 2.2, 2.2, 2.2	0	1.265	1.270	1.270	1.275			
				(2) 2.3, 2.2, 2.2, 2.2		1.270	1.280	1.270	1.280			
				(3) 2.2, 2.2, 2.2, 2.2		1.280	1.280	1.270	1.285			
28	W/C, BA–730, USA 252530	2–H	C	(1) 2.3, 2.3, 2.3, 2.3	0	1.270	1.280	1.280	1.270			
				(2) 2.3, 2.3, 2.3, 2.3		1.275	1.280	1.280	1.275			
				(3) 2.3, 2.3, 2.3, 2.3		1.270	1.280	1.280	1.275			
29	W/C, BA–724, USA 276307	2–H	C	(1) 2.3, 2.2, 2.2, 2.2	0	1.275	1.270	1.265	1.270			
				(2) 2.3, 2.2, 2.2, 2.2		1.270	1.270	1.255	1.260			
				(3) 2.5, 2.2, 2.2, 2.2		1.280	1.280	1 270	1.270			
30	W/C, BA–729, USA 275732	2–H	C	(1) 2.5, 2.2, 2.3, 2.3	0	1.280	1.280	1.280	1.290			
				(2) 2.3, 2.2, 2.3, 2.5		1.290	1.270	1.280	1.285			
				(3) 2.3, 2.2, 2.5, 2.5		1.280	1.270	1.270	1.280			

31	Jeep, BA-151, USA 20369993	2-H	D	(1) 2.3, 2.1, 2.3, 2.3, 2.3	0	1.280	1.270	1.280	1.290	1.280		
				(2) 2.3, 2.1, 2.3, 2.3, 2.3		1.280	1.275	1.280	1.290	1.290		
				(3) 2.3, 2.1, 2.3, 2.3, 2.3		1.280	1.270	1.280	1.290	1.280		
32	Jeep, BA-165, USA 20766772	2-H	D	(1) 2.1, 2.1, 2.1, 2.2, 2.2	0	1.230	1.240	1.250	1.250	1.255		
				(2) 2.1, 2.1, 2.1, 2.2, 2.2		1.240	1.250	1.260	1.260	1.265		
				(3) 2.1, 2.1, 2.1, 2.2, 2.2		1.220	1.235	1.245	1.240	1.255		
33	Jeep, BA-119, USA 20368472	2-H	D	(1) 2.2, 2.2, 2.2, 2.2, 2.2	0	1.240	1.240	1.240	1.245	1.240		
				(2) 2.2, 2.2, 2.2, 2.2, 2.2		1.250	1.250	1.250	1.255	1.250		
				(3) 2.2, 2.2, 2.2, 2.2, 2.2		1.260	1.250	1.260	1.270	1.260		
34	Jeep, BA-150, USA 2047347	2-H	D	(1) 2.3, 2.1, 2.1, 2.2, 2.2	0	1.265	1.270	1.250	1.260	1.270		
				(2) 2.3, 2.1, 2.1, 2.2, 2.2		1.265	1.270	1.240	1.265	1.270		
				(3) 2.3, 2.1, 2.1, 2.2, 2.2		1.265	1.270	1.240	1.270	1.270		
35	Jeep, BA-162, USA 20619543	2-H	D	(1) 2.2, 2.2, 2.2, 2.2, 2.2	0	1.260	1.260	1.260	1.260	1.275		
				(2) 2.2, 2.2, 2.2, 2.2, 2.2		1.250	1.255	1.250	1.260	1.270		
				(3) 2.2, 2.2, 2.2, 2.2, 2.2		1.260	1.260	1.260	1.260	1.270		
36	Jeep, BA-136, USA 20300482	2-H	D	(1) 2.0, 2.2, 2.3, 2.3, 2.3	0	1.150	1.260	1.270	1.280	1.290		This battery showed 250 amps at 4.5 volts on breakdown test.
				(2) 2.0, 2.2, 2.3, 2.3, 2.3		1.150	1.250	1.280	1.290	1.300		
				(3) 2.0, 2.2, 2.3, 2.3, 2.3		1.150	1.260	1.275	1.280	1.290		
37	Jeep, BA-156, USA 20760098	2-H	D	(1) 2.2, 2.2, 2.1, 2.2, 2.2	0	1.270	1.270	1.260	1.270	1.260		
				(2) 2.2, 2.2, 2.1, 2.2, 2.2		1.270	1.270	1.260	1.260	1.260		
				(3) 2.2, 2.2, 2.1, 2.2, 2.2		1.270	1.270	1.260	1.260	1.260		
38	Jeep, BA-118, USA 2039220	2-H	D	(1) 2.3, 2.3, 2.3, 2.2, 2.2	0	1.255	1.260	1.270	1.260	1.260		
				(2) 2.3, 2.3, 2.3, 2.2, 2.2		1.260	1.260	1.265	1.270	1.260		
				(3) 2.3, 2.3, 2.3, 2.2, 2.2		1.255	1.260	1.260	1.260	1.260		
39	Jeep, BA-132, USA 20307479	2-H	D	(1) 2.2, 2.3, 2.2, 2.2, 2.3	0	1.290	1.285	1.280	1.285	1.285		
				(2) 2.2, 2.3, 2.2, 2.2, 2.3		1.280	1.280	1.270	1.280	1.285		
				(3) 2.2, 2.3, 2.2, 2.2, 2.3		1.280	1.280	1.270	1.280	1.285		
40	Jeep, BA-169, USA 20767182	2-H	D	(1) 2.2, 2.2, 2.0, 2.0, 2.3	0	1.270	1.275	1.230	1.270	1.290		
				(2) 2.2, 2.1, 2.0, 2.0, 2.3		1.250	1.260	1.230	1.255	1.265		
				(3) 2.2, 2.1, 2.0, 2.0, 2.3		1.260	1.270	1.215	1.260	1.270		

DEPARTMENT OF THE ARMY HEADQUARTERS, BENECIA ARSENAL,
OFFICE OF THE COMMANDING OFFICER,
Benecia, Calif., May 6, 1949.

Subject: Letter report on field service test of transport vehicle batteries containing Protecto-Charge.
To: Chief of Ordnance, Department of the Army, Washington 25, D. C.
(Attention: ORDFM–Auto.)

Reference letter from your office dated October 22, 1948, subject as above, file O. O. 412.4/925, letter report for month of April 1949 attached hereto.

For the commanding officer:

STEPHEN J. MILLET,
Lieutenant Colonel, Ordnance Department Assistant.

1 enclosure, letter report for April 1949.

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
1	W/C, BA-761, USA 277606	2-H	A	(1)							Dec. 31, 1948	Failure.
2	W/C, BA-782, USA 2168006	2-H	A	(1) 2.2, 2.3, 2.3, 2.3	0	1.260	1.275	1.275	1.275			
				(2) 2.2, 2.3, 2.3, 2.3		1.270	1.280	1.280	1.285			
				(3) 2.2, 2.3, 2.3, 2.3		1.280	1.275	1.290	1.300			
3	W/C, BA-777, USA 2175648	2-H	A	(1) 2.2, 2.0, 2.1, 2.2	0	1.240	1.245	1.255	1.250			
				(2) 2.2, 2.0, 2.1, 2.2		1.250	1.260	1.265	1.260			
				(3) 2.2, 2.0, 2.1, 2.2		1.240	1.250	1.255	1.250			
4	W/C, BA-784, USA 2162897	2-H	A	(1)							Dec. 31, 1948	Do.
5	W/C, BA-759, USA 2120106	2-H	A	(1) 2.0, 2.1, 2.0, 2.0	0	1.230	1.230	1.225	1.205			
				(2) 2.0, 2.1, 2.0, 2.1		1.240	1.240	1.235	1.220			
				(3) 2.0, 2.1, 2.0, 2.1		1.230	1.230	1.240	1.220			
6	W/C, BA-773, USA 2161747	2-H	A	(1) 2.2, 3.2, 2.1, 2.2	0	1.250	1.250	1.270	1.255			
				(2) 2.2, 2.3, 2.1, 2.2		1.260	1.260	1.260	1.260			
				(3) 2.2, 2.3, 2.1, 2.2		1.270	1.270	1.250	1.275			
7	W/C, BA-750, USA 2113601	2-H	A	(1)							Dec. 31, 1948	Do.
8	W/C, BA-756	2-H	A	(1)							Dec. 31, 1948	Do.
9	W/C, BA-780, USA 2303475	2-H	A	(1)							Dec. 31, 1948	Do.
10	W/C, BA-776, USA 2168328	2-H	A	(1) 2.2, 2.3, 2.2, 2.3	0	1.265	1.270	1.275	1.275			
				(2) 2.2, 2.3, 2.2, 2.3		1.275	1.270	1.275	1.280			
				(3) 2.2, 2.3, 2.2, 2.3		1.265	1.280	1.280	1.275			
11	Jeep, BA-154, USA 2069439	2-H	B	(1) 2.2, 2.2, 2.3, 2.3	0	1.260	1.260	1.255	1.270			
				(2) 2.2, 2.2, 2.3, 2.3		1.275	1.270	1.280	1.285			
				(3) 2.2, 2.2, 2.3, 2.3		1.275	1.270	1.265	1.270			
12	Jeep, BA-181, USA 20309313	2-H	B	(1) 2.2, 2.3, 2.3, 2.3	0	1.280	1.285	1.265	1.265			
				(2) 2.2, 2.3, 2.3, 2.3		1.290	1.290	1.285	1.280			
				(3) 2.2, 2.3, 2.3, 2.3		1.300	1.300	1.290	1.290			
13	Jeep, BA-177, USA 20594739	2-H	B	(1) 2.2, 2.4, 2.3, 2.3	0	1.275	1.290	1.280	1.285			
				(2) 2.2, 2.4, 2.3, 2.3		1.270	1.285	1.285	1.275			
				(3) 2.2, 2.4, 2.3, 2.3		1.285	1.300	1.295	1.290			
14	Jeep, BA-126, USA 2036750	2-H	B	(1) 2.2, 2.3, 2.2, 2.2	0	1.210	1.220	1.220	1.215			
				(2) 2.2, 2.3, 2.2, 2.3		1.240	1.250	1.235	1.240			
				(3) 2.2, 2.3, 2.2, 2.3		1.225	1.240	1.230	1.230			
15	Jeep, BA-164, USA 20767294	2-H	B	(1) 2.2, 2.3		1.240	1.245				Apr. 19, 1949	Dead center cell. Separators rotten due to age. Dated 5-44. Removed from test.
				(2) 2.2, 2.3		1.230	1.230					
				(3) 2.0, 2.2		1.170	1.210					
16	Jeep, BA-101, USA 20124062	2-H	B	(1) 2.2, 2.2, 2.2, 2.2	0	1.255	1.260	1.260	1.255			
				(2) 2.2, 2.2, 2.1, 2.2		1.240	1.250	1.240	1.240			
				(3) 2.2, 2.2, 2.1, 2.2		1.235	1.240	1.230	1.230			
17	Jeep, BA-153, USA 20658409	2-H	B	(1) 2.3, 2.3, 2.3, 2.3	0	1.300	Dry	1.300	1.300			
				(2) 2.3, 2.3, 2.3, 2.3		1.300	Dry	1.300	1.300			
				(3) 2.3, 2.3, 2.3, 2.3		1.270	Dry	1.280	1.260			

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
18	Jeep, BA–141, USA 20371253	2–H	B	(1) 1.9, 2.2, 2.2, 2.3	1	Dead	1.280	1.270	1.270		Apr. 5, 1949	Replaced Apr. 12, 1949.
				(2) 2.0, 2.2, 2.2, 2.3		do	1.280	1.270	1.275			
19	Jeep, BA–133, USA 20300615	2–H	B	(3) 2.0, 2.2, 2.2, 2.3		do	1.280	1.265	1.270			
				(1) 2.2, 2.2, 2.3, 2.3	0	1.260	1.270	1.265	1.270			
20	Jeep, BA–182, USA 20158854	2–H	B	(2) 2.2, 2.2, 2.3, 2.3		1.270	1.280	1.280	1.285			
21	W/C, BA–723, USA 288922	2–H	C	(3) 2.2, 2.2, 2.3, 2.3		1.250	1.255	1.255	1.260			
				(1)								
22	W/C, BA–755, USA 280460	2–H	C	(1) 2.2, 2.2, 2.3, 2.3, 2.3	0	1.270	1.270	1.280	1.275	1.285	Dec. 31, 1948	Failure.
				(2) 2.2, 2.2, 2.3, 2.3, 2.3		1.285	1.290	1.295	1.290	1.280		
				(3) 2.2, 2.2, 2.3, 2.3, 2.3		1.270	1.290	1.295	1.285	1.280		
23	W/C, BA–727, USA 20118998	2–H	C	(1) 2.2, 2.2, 2.3, 2.2, 2.3	0	1.290	1.295	1.290	1.290	1.300		
				(2) 2.2, 2.2, 2.3, 2.2, 2.3		1.280	1.290	1.285	1.280	1.290		
				(3) 2.2, 2.2, 2.3, 2.2, 2.3		1.290	1.280	1.290	1.290	1.300		
24	W/C, BA–732, USA 2116271	2–H	C	(1) 2.3, 2.2, 2.3, 2.2, 2.3	0	1.300	1.300	1.300	1.270	1.295		
				(2) 2.3, 2.2, 2.3, 2.2, 2.3		1.290	1.290	1.300	1.260	1.280		
				(3) 2.3, 2.2, 2.3, 2.2, 2.3		1.290	1.280	1.300	1.260	1.280		
25	W/C, BA–785, USA 2166964	2–H	C	(1) 2.2, 2.2, 2.3, 2.2, 2.3	0	1.275	1.275	1.270	1.265	1.260		
				(2) 2.2, 2.2, 2.3, 2.2, 2.3		1.280	1.280	1.280	1.270	1.275		
				(3) 2.2, 2.2, 2.3, 2.2, 2.3		1.270	1.275	1.270	1.255	1.260		
26	W/C, BA–734, USA 258116	2–H	C	(1) 2.2, 2.2, 2.3, 2.3, 2.3	0	1.270	1.270	1.270	1.270	1.285		
				(2) 2.2, 2.2, 2.3, 2.3, 2.3		1.270	1.275	1.270	1.270	1.285		
				(3) 2.2, 2.2, 2.3, 2.3, 2.3		1.260	1.290	1.280	1.280	1.290		
27	W/C, BA–726, USA 20120029	2–H	C	(1) 2.2, 2.2, 2.2, 2.2, 2.2	0	1.270	1.270	1.260	1.250	1.260		
				(2) 2.2, 2.2, 2.2, 2.2, 2.2		1.270	1.270	1.260	1.255	1.265		
				(3) 2.2, 2.2, 2.2, 2.2, 2.2		1.280	1.280	1.270	1.260	1.275		
28	W/C, BA–730, USA 252330	2–H	C	(1) 2.0, 2.2, 2.2, 2.1, 2.3	0	1.275	1.260	1.270	1.265	1.260		
				(2) 2.0, 2.2, 2.2, 2.1, 2.3		1.260	1.265	1.270	1.265	1.265		
				(3) 2.0, 2.2, 2.2, 2.1, 2.3		1.270	1.260	1.260	1.260	1.260		
29	W/C, BA–734, USA 276307	2–H	C	(1) 2.1, 2.1, 2.3, 2.3, 2.3	0	1.260	1.260	1.270	1.270	1.280		
				(2) 2.1, 2.1, 2.3, 2.3, 2.3		1.255	1.260	1.280	1.270	1.275		
				(3) 2.1, 2.1, 2.3, 2.3, 2.3		1.255	1.270	1.270	1.275	1.275		
30	W/C, BA–729, USA 275732	2–H	C	(1) 2.2, 2.1, 2.3, 2.2, 2.3	0	1.260	1.260	1.260	1.260	1.265		
				(2) 2.1, 2.1, 2.3, 2.2, 2.3		1.250	1.250	1.255	1.240	1.255		
				(3) 2.1, 2.1, 2.3, 2.2, 2.3		1.255	1.250	1.260	1.250	1.260		
31	Jeep, BA–151, USA 20369903	2–H	D	(1) 2.2, 2.3, 2.3, 2.3, 2.3	0	1.280	1.290	1.295	1.280	1.290		
				(2) 2.2, 2.3, 2.3, 2.3, 2.3		1.280	1.290	1.290	1.280	1.285		
				(3) 2.2, 2.3, 2.3, 2.3, 2.3		1.275	1.280	1.290	1.290	1.285		
				(1) 2.1, 2.3, 2.3, 2.3	0	1.280	1.280	1.280	1.270			
				(2) 2.1, 2.3, 2.3, 2.3		1.280	1.280	1.280	1.280			
				(3) 2.1, 2.3, 2.3, 2.3		1.275	1.280	1.275	1.270			
32	Jeep, BA–165, USA 20766772	2–H	D	(1) 2.1, 2.3, 2.3, 2.0								

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DEPARTMENT OF THE ARMY,
HEADQUARTERS BENICIA ARSENAL,
OFFICE OF THE COMMANDING OFFICER,
Benicia, Calif., June 21, 1949.

Subject: Letter report on field service test of transport vehicle batteries containing Protecto-Charge.

To: Chief of Ordnance, Department of the Army, Washington 25, D. C.
(Attention ORDFM–Auto.)

Reference letter from your office dated October 22, 1948, subject as above, file 0.0. 412.4/925, letter report on completion of test attached hereto.

For the commanding officer:

STEPHEN J. MILLET,
Lieutenant Colonel, Ordnance Department,
Assistant.

One enclosure, letter report on completion of test.

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
1	W/C, BA–761 USA 277606	2–H	A	(1)							Dec. 31, 1948	Failure.
2	W/C, BA–782	2–H	A	(1) 2.3, 2.3		1.265	1.275					Positive plates very bad. Negative plates clean and O. K. ½₃₂-inch sediment. Spun-glass separators.
				(2) 2.3, 2.3		1.270	1.280					
				(3) 2.3, 2.3		1.280	1.285					
3	W/C, BA–777 USA 2175648	2–H	A	(1) 2.2, 2.2		1.250	1.255					Positive plates very bad. Negative plates clean and O. K. ½₃₂-inch sediment. Wood separators.
				(2) 2.2, 2.2		1.260	1.260					
				(3) 2.2, 2.2		1.250	1.260					
4	W/C, BA–785, USA 2162897	2–H	A	(1)							Dec. 31, 1948	Failure.
5	W/C, BA–759, USA 2120106	2–H	A	(1) 2.1, 2.1		1.225	1.230					Positive plates bad. Negative plates clean and O. K. ⅛-inch sediment. Rubber separators.
6	W/C, BA–773, USA 2161747	2–H	A	(1) 2.3, 2.3		1.260	1.265					Positive plates in fair shape. Negative plates clean and O. K. ½₃₂-inch sediment. Rubber separators.
				(2) 2.3, 2.3		1.270	1.270					
				(3) 2.3, 2.3		1.275	1.275					
7	W/C, BA–750, USA 2113601	2–H	A	(1)							Dec. 31, 1948	Failure.
8	W/C, BA–756, USA 274336	2–H	A	(1)							do	Do.
9	W/C, BA–780, USA 230475	2–H	A	(1)							do	Do.
10	W/C, BA–776, USA 2168328	2–H	A	(1) 2.3, 2.3		1.270	1.275					Positive plates in fair shape. Negative plates clean and O. K. ½₃₂-inch sediment. Wood separators.
				(2) 2.3, 2.3		1.270	1.275					
				(3) 2.3, 2.3		1.275	1.275					
11	Jeep, BA–154, USA 20697439	2–H	B	(1) 2.3, 2.3		1.275	1.280					Plates in fair shape. ½₃₂-inch sediment. Spun-glass separators.
				(2) 2.3, 2.3		1.290	1.290					
				(3) 2.3, 2.3		1.280	1.280					
12	Jeep, BA–181, USA 20500313	2–H	B	(1) 2.3, 2.3		1.270	1.275					Plates in good shape. ½₃₂-inch sediment. Wood separators.
				(2) 2.3, 2.3		1.280	1.280					
				(3) 2.3, 2.3		1.295	1.290					
13	Jeep, BA–177, USA 20594739	2–H	B	(1) 2.3, 2.3		1.285	1.285					Plates in good shape. Very slight sediment. Spun-glass separators.
				(2) 2.3, 2.3		1.280	1.285					
				(3) 2.3, 2.3		1.295	1.295					
14	Jeep, BA–126, USA 2036750	2–H	B	(1) 2.2, 2.2		1.215	1.225					Plates in poor shape. ⅛-inch sediment. Rubber separators.
				(2) 2.2, 2.2		1.240	1.250					
				(3) 2.2, 2.2		1.225	1.230					
15	Jeep, BA–164, USA 20767294	2–H	B								Apr. 19, 1949	Failure.

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
16	Jeep, BA–101, USA20124062	2–H	B	(1) 2.3, 2.3		1.265	1.270					Plates in good shape. 1/32-inch sediment. Wood separators.
				(2) 2.3, 2.3		1.250	1.265					
				(3) 2.3, 2.3		1.240	1.260					
17	Jeep, BA–153, USA20658409	2–H	B	(1) 2.3, 2.3		1.300	1.300					Plates in fine shape. Very slight sediment. Wood separators.
				(2) 2.3, 2.3		1.300	1.300					
				(3) 2.3, 2.3		1.280	1.290					
18	Jeep, BA–141, USA20371253	2–H	B	(1) 2.3, 2.3		1.280	1.280					Do.
				(2) 2.3, 2.3		1.280	1.280					
				(3) 2.3, 2.3		1.280	1.280					
19	Jeep, BA–133, USA20300615	2–H	B	(1) 2.2, 2.2		1.265	1.270					Plates in fair shape. 1/32-inch sediment. Spun-glass separators.
				(2) 2.2, 2.2		1.275	1.275					
				(3) 2.2, 2.2		1.255	1.265					
20	Jeep, BA–182, USA20158854	2–H	B								Dec. 31, 1948	Failure.
21	W/C, BA–723, USA288922	2–H	C	(1) 2.3, 2.3		1.270	1.275					Plates like new. Very slight sediment. Wood separators.
				(2) 2.3, 2.3		1.280	1.280					
				(3) 2.3, 2.3		1.285	1.280					
22	W/C, BA–755, USA280460	2–H	C	(1) 2.3, 2.1		1.290	1.260					Do.
				(2) 2.3, 2.1		1.290	1.240					
				(3) 2.3, 2.1		1.285	1.260					
23	W/C, BA–727, USA20118998	2–H	C	(1) 2.3, 2.3		1.300	1.300					Do.
				(2) 2.3, 2.3		1.295	1.300					
				(3) 2.3, 2.3		1.290	1.295					
24	W/C, BA–732, USA2116271	2–H	C	(1) 2.3, 2.2		1.260	1.260					Do.
				(2) 2.3, 2.2		1.260	1.280					
				(3) 2.3, 2.2		1.250	1.265					
25	W/C, BA–785 USA2166964	2–H	C	(1) 2.3, 2.3		1.265	1.270					Plates like new. 1/32-inch sediment. Wood separators.
				(2) 2.3, 2.3		1.265	1.270					
				(3) 2.3, 2.3		1.280	1.280					
26	W/C, BA–734 USA258116	2–H	C	(1) 2.2, 2.2		1.250	1.250					Do.
				(2) 2.2, 2.2		1.250	1.255					
				(3) 2.2, 2.2		1.260	1.260					
27	W/C, BA–725 USA20120029	2–H	C	(1) 2.2, 2.2		1.260	1.255					Plates like new. 1/16-inch sediment. Wood separators.
				(2) 2.2, 2.2		1.270	1.270					
				(3) 2.2, 2.2		1.260	1.270					
28	W/C, BA–730 USA252330	2–H	C	(1) 2.3, 2.3		1.270	1.280					Plates like new. Very little sediment. Wood separators.
				(2) 2.3, 2.3		1.275	1.280					
				(3) 2.3, 2.3		1.275	1.285					
29	W/C, BA–724 USA276307	2–H	C	(1) 2.2, 2.2		1.260	1.260					Plates like new. 1/32-inch sediment. Wood separators.
				(2) 2.2, 2.2		1.250	1.255					
				(3) 2.2, 2.2		1.260	1.260					

30	W/C, BA–729 USA275732	2–H	C	(1) 2.3, 2.3		1.275	1.280				Plates like new. Very little sediment. Wood separators.
				(2) 2.3, 2.3		1.270	1.275				
				(3) 2.3, 2.3		1.270	1.275				
31	Jeep, BA–151 USA20369993	2–H	D	(1) 2.1, 2.3		1.190	1.270				Plates like new. 1/32-inch sediment. Wood separators.
				(2) 2.1, 2.3		1.190	1.275				
				(3) 2.1, 2.3		1.190	1.270				
32	Jeep, BA–165 USA20766772	2–H	D	(1) 2.0, 2.2		1.175	1.245				Plates like new. 1/16-inch sediment. Wood separators.
				(2) 2.0, 2.2		1.190	1.255				
				(3) 2.0, 2.2		1.180	1.250				
33	Jeep, BA–119 USA20368472	2–H	D	(1) 2.3, 2.3		1.260	1.260				Plates like new. 1/32-inch sediment. Wood separators.
				(2) 2.3, 2.3		1.260	1.270				
				(3) 2.3, 2.3		1.250	1.260				
34	Jeep, BA–150, USA 2047347	2–H	D	(1) 2.3, 2.3		1.270	1.280				Do.
				(2) 2.3, 2.3		1.260	1.275				
				(3) 2.3, 2.3		1.260	1.275				
35	Jeep, BA–162 USA 20619543	2–H	D	(1) 2.3, 2.3		1.270	1.270				Do.
				(2) 2.3, 2.3		1.270	1.270				
				(3) 2.3, 2.3		1.270	1.270				
36	Jeep, BA–136 USA 20300482	2–H	D	(1) 2.3, 2.3		1.280	1.285				Do.
				(2) 2.4, 2.4		1.290	1.290				
				(3) 2.4, 2.4		1.290	1.290				
37	Jeep, BA–156 USA 20760098	2–H	D	(1) 2.2, 2.2		1.210	1.225				Plates like new. 1/16 inch sediment. Wood separators.
				(2) 2.2, 2.2		1.220	1.230				
				(3) 2.2, 2.2		1.210	1.220				
38	Jeep, BA–118 USA 2039220	2–H	D	(1) 2.3, 2.3		1.260	1.270				Plates like new, 1/32 inch sediment. Wood separators.
				(2) 2.3, 2.3		1.270	1.270				
				(3) 2.3, 2.3		1.260	1.270				
39	Jeep, BA–132 USA 20307497	2–H	D	(1) 2.3, 2.3		1.290	1.285				Plates like new. 1/16 inch sediment. Wood separators.
				(2) 2.3, 2.3		1.290	1.285				
				(3) 2.3, 2.3		1.290	1.285				
40	Jeep, BA–169 USA 20767152	2–H	D	(1) 2.2, 2.2		1.270	1.270				Do.
				(2) 2.2, 2.2		1.260	1.270				
				(3) 2.2, 2.2		1.265	1.265				

Last reading when battery was removed from vehicle.

HEADQUARTERS MOUNT RAINIER ORDNANCE DEPOT,
Tacoma, Wash., September 17, 1948.

Subject: Report on field service test of transport vehicle batteries containing Protecto-Charge.

To: Chief of Ordnance, Department of the Army, Washington 25, D. C.
(Attention ORDFM–Auto.)

Enclosed is initial subject report forwarded in compliance with your letter, subject as above, dated August 9, 1948, file: 00 412.4/877.

LOUIS L. JORDAN,
Lieutenant Colonel, Ordnance Department, Commanding.

1 enclosure, report (in duplicate).

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
1	Ply. sedan 142852	M–1	A	2, 2, 2		1.160 1.160 1.140						Installed Sept. 1, 1948.
2	Trk, ¼ T 4 x 4, 207087532	2–H	A	2, 1.9, 2		1.280 1.280						Do.
3	Trk, ½ T 4 x 2 pickup, 256630	2–H	A	2, 2, 2		1.280 1.180 1.220						Do.
4	Trk, ½ T 4 x 2 pickup, 256962	2–H	A	2, 2, 2		1.200 1.280 1.280						Do.
5	Trk, ½ T 4 x 2 pickup, 255064	2–H	A	2.2, 2, 2.2		1.280 1.280 1.250						Do.
6	Trk, 2½ T 4 x 2 dump, 4453006	4–H	A	2, 2, 2		1.280 1.280 1.280						Do.
7	Trk, 1½ T 4 x 2 stake, 3146144	2–H	A	2, 2, 2		1.280 1.260 1.240						Do.
8	Trk, 1½ T 4 x 2 stake, 367419	2–H	A	2, 2, 2		1.280 1.280 1.280						Do.
9	Trk, 5 T 4 x 2, Tractor, 571552	4–H	A	2, 2, 2		1.280 1.280 1.280						Do.
10	Trk, 5 T 4 x 2, Tractor, 571552	4–H	A	2, 2, 2		1.280 1.280 1.280						Do.
11	Sedan (Chev.), 142014	M–1	B	2, 2, 2		1.280 1.280 1.280						Do.
12	Trk, ¼ T 4 x 4, 20302591	2–H	B	2, 2, 2		1.240 1.240 1.240						Do.
13	Trk, ½ T 4 x 2, Pickup 2200298	M–1	B	2, 2, 2		1.240 1.260 1.240						Do.

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
14	Trk, ½ T 4 x 2, Pickup, 255172.	2-H	B	2, 2, 2		1.280 1.280 1.280						Installed Sept. 1, 1948.
15	Trk, ½ T 4 x 2, Pickup, 255126.	2-H	B	2, 2, 2		1.270 1.270						Do.
16	Trk, 2½ T 4 x 2, Dump, 4453001.	4-H	B	2, 2, 2		1.180 1.180 1.180						Do.
17	Trk, 1½ T 4 x 2 stake, 367379.	2-H	B	2, 2, 2		1.280 1.280 1.280 1.280						Do.
18	Trk, 1½ T 4 x 2 stake, 367373.	2-H	B	2, 2, 2		1.260 1.280 1.260						Do.
19	Trk, 5 T 4 x 2 tractor, 571548.	4-H	B	2, 2, 2		1.280 1.280 1.280						Do.
20	Trk, 5 T 4 x 2 tractor, 571548.	4-H	B	2, 2, 2		1.280 1.280 1.280						Do.
21	Sedan, Ply., 141835	M-1	C	2, 2, 2		1.240 1.250 1.240						Do.
22	Trk, ¼ T 4 x 4, 20304108	2-H	C	2, 2, 2		1.280 1.280 1.280						Do.
23	Trk, ½ T 4 x 2 pickup, 244359.	2-H	C	2, 2, 2		1.280 1.280 1.280						Do.
24	Trk, ½ T 4 x 2 pickup, 295785.	M-1	C	2, 2, 2		1.280 1.280 1.280						Do.
25	Trk, ½ T 4 x 2, pickup 2267031.	M-1	C	2,2 2		1.280 1.280 1.280						Do.
26	Trk, ½ T 4 x 2, pickup 296953.	2-H	C	2,2 2		1.280 1.270 1.280						Do.
27	Trk, 2½ T 4 x 2, dump 4109937.	4-H	C	2,2 2		1.280 1.280 1.280						Do.

28	Trk, 2½ T 4 x 2, dump 4110213.	4–H	C	2,2 2		1. 280 1. 280 1. 280							Do.
29	Trk, 1½ T 4 x 2 stake, 366967	2–H	C	2,2 2		1. 280 1. 280 1. 280							Do.
30	Trk, 1½ T 4 x 2, stake 3280410.	2–H	C	2,2 2		1. 280 1. 280 1. 280							Do.
31	Sedan, Chev, 143169	M–1	D	2,2 2		1. 270 1. 270 1. 270							Do.
32	Trk, 4 x 2 carryall, 295319	2–H	D	2, 2, 2		1. 290 1. 290 1. 290							Do.
33	Trk, ½ T 4 x 2, pickup 244941.	M–1	D	2, 2, 2		1. 280 1. 280 1. 280							Do.
34	Trk, ½ T 4 x 2, pickup 243268.	M–1	D	2, 2, 2		1. 240 1. 240 1. 240							Do.
35	Trk, ½ T 4 x 2, pickup 2269304.	2–H	D	2, 2, 2		1. 280 1. 280 1. 280							Do.
36	Trk, ¼ T 4 x 2, pickup 298440.	2–H	D	2, 2. 2		1. 270 1. 270 1. 270							Do.
37	Trk, 2½ T 4 x 2, pickup 492653.	4–H	D	2, 2, 2		1. 280 1. 280 1. 280							Do.
38	Trk, 2½ T 4 x 2, dump 4109307.	4–H	D	2, 2, 2		1. 290 1. 290 1. 290							Do.
39	Trk, 1½ T 4 x 2, stake 367378.	4–H	D	2, 2, 2		1. 280 1. 280 1. 280							Do.
40	Trk, 1½ T 4 x 2, stake 366966.	2–H	D	2, 2, 2		1. 280 1. 280 1. 280							Do.

Explanatory note: All batteries with the exception of Type A and B were new, charged batteries.

OCTOBER 4, 1948.

Subject: Report on field service test of transport vehicle batteries containing Protecto-Charge.

To: Chief of Ordnance, Department of the Army, Washington 25, D. C.
(Attention: ORDFM–Auto.)

Enclosed is subject report for month of September forwarded in compliance with your letter, subject as above, dated August 9, 1948, file: 00 412.4/877.

LOUIS L. JORDAN,
Lieutenant Colonel, Ordnance Department,
Commanding.

1 enclosure, report (in duplicate).

Line No.	Vehicle nomenclature and United States registry No.	Battery type: Standard nomenclature	Battery type: Type, A, B, C, D	Voltage reading from test	Number of times battery received charge this month	Specific gravity: 1st week	2d week	3d week	4th week	5th week	Date battery was removed	Remarks
1	Ply. Sedan, 142852	M-1	A	2, 2, 2	1	1.180	1.190	1.240				
						1.200	1.220	1.240				
						1.200	1.200	1.240				
2	Trk, ¼ T 4 x 4, 20708755	2-H	A	2, 1 9, 2	0	1.300	1.300	1.280				
						1.300	1.300	1.280				
						1.300	1.300	1.280				
3	Trk, ½ T 4 x 2, pickup 256630.	2-H	A	2, 2, 2	0	1.260	1.200	1.200	1.180			
						1.260	1.190	1.200	1.180			
						1.260	1.200	1.200	1.180			
4	Trk, ½ T 4 x 2, 256962	2-H	A	2, 2, 2	0	1.280	1.260	1.280				
						1.280	1.280	1.280				
						1.280	1.280	1.280				
5	Trk, ½ T 4 x 2, 255064	2-H	A	2, 2, 2	0	1.220	1.240	1.220	1.220			
						1.240	1.220	1.220	1.220			
						1.250	1.200	1.220	1.160			
6	Trk, 2½ T 4 x 2, dump 4453006.	4-H	A	2, 2, 2	0	1.260	1.280	1.270	1.260			
						1.260	1.260	1.240	1.260			
						1.240	1.280	1.260	1.260			
7	Trk, 1½ T 4 x 2, stake 3146144.	2-H	A	2, 2, 2	1	-------	1.280	1.260	1.240			Vehicle in shop for repairs.
						-------	1.260	1.260	1.220			
						-------	1.280	1.260	1.230			
8	Trk, 1½ T 4 x 2, stake 367419.	2-H	A	2, 2, 2	0	1.220	1.240	1.260	1.240			
						1.220	1.240	1.260	1.260			
						1.260	1.260	1.280	1.280			
9	Trk, 5 T 4 x 2, tractor 591552.	4-H	A	2, 2, 2	0	1.260	1.270	1.260	1.240			
						1.260	1.270	1.260	1.250			
						1.260	1.270	1.260	1.230			
10	Trk, 5 T 4 x 2, tractor 591552.	4-H	A	2, 2, 2	0	1.260	1.270	1.270	1.260			
						1.260	1.270	1.270	1.260			
						1.260	1.270	1.270	1.260			
11	Sedan (Chev.), 142614	M-1	B	2, 2, 2	1	1.270	1.260	1.240	1.280			Do.
						1.270	1.260	1.240	1.280			
						1.270	1.260	1.240	1.280			
12	Trk, ¼ T 4 x 4, 20302591	2-H	B	2, 2, 2	2	-------	1.270	1.200				Patrol vehicle radio equipment in shop for repairs.
						-------	1.260	1.200				
						-------	1.280	1.200				
13	Trk, ½ T 4x2, pickup, 2200298	M-1	B	2, 2, 2	1	1.240	1.260	1.200				Vehicle in shop for repairs.
						1.240	1.260	1.200				
						1.240	1.260	1.200				

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
14	Trk, ½ T 4 x 2, pickup, 255172	2-H	B	2, 2, 2	0	1. 260 1. 260 1. 260	1. 240 1. 240 1. 240	1. 280 1. 280 1. 280	1. 260 1. 260 1. 260			
15	Trk, ½ T 4 x 2, 255126	2-H	B	2, 2, 2	0	1. 260 1. 260 1. 260	1. 260 1. 260 1. 260	1. 260 1. 260 1. 260	1. 260 1. 260 1. 260			
16	Trk, 2½ T 4 x 2, dump 4453001.	4-H	B	2, 2, 2	0	1. 260 1. 200 1. 200 1. 200	1. 260 1. 220 1. 220 1. 220	1. 260 1. 180 1. 180 1. 180	1. 260 1. 160 1. 180 1. 180			
17	Trk, 1½ T., 4 x 2, stake, 367379.	2-H	B	2, 2, 2	0	1. 260 1. 260 1. 260	1. 260 1. 260 1. 260	1. 280 1. 280 1. 280	1. 280 1. 280 1. 280			
18	Trk, 1½ T. 4 x 2, 367373	2-H	B	2, 2, 2	0	1. 260 1. 240 1. 260	1. 260 1. 240 1. 240	1. 280 1. 220 1. 200	1. 280 1. 220 1. 180			
19	Trk, 5 T. 4 x 2, tractor, 571548.	4-H	B	2, 2, 2	0	1. 260 1. 260 1. 260	1. 260 1. 260 1. 260	1. 260 1. 260 1. 240	1. 240 1. 260 1. 240			
20	Trk, 5 T. 4 x 2, tractor, 571548.	4-H	B	2, 2, 2	0	1. 260 1. 260 1. 260	1. 260 1. 260 1. 260	1. 240 1. 250 1. 250	1. 240 1. 260 1. 260			
21	Ply. sedan, 141835	M–1	C	2, 2, 2	0	1. 240 1. 240 1. 240	1. 280 1. 280 1. 280	1. 280 1. 280 1. 280				Vehicle in shop for repairs.
22	Trk, ¾ T. 4 x 4, 20304108	2-H	C	2, 2, 2	0	1. 270 1. 270 1. 260	1. 280 1. 280 1. 280	1. 260 1. 260 1. 260	1. 270 1. 270 1. 270			
23	Trk, ½ T. 4 x 2, 244359	2-H	C	2, 2, 2	0	1. 270 1. 270 1. 270	1. 260 1. 260 1. 260	1. 200 1. 200 1. 200	1. 200 1. 200 1. 200			
24	Trk, ½ T. 4 x 2, 296785	M–1	C	2, 2, 2	0	1. 270 1. 270 1. 200	1. 280 1. 280 1. 300	1. 300 1. 300 1. 300	1. 280 1. 280 1. 300			
25	Trk, ½ T 4 x 2, 2267031	M–1	C	2, 2, 2	0	1. 260 1. 260 1. 260	1. 280 1. 280 1. 280	1. 280 1. 280 1. 280	1. 280 1. 280 1. 280			
26	Trk ½ T 4 x 2, 296953	2-H	C	2, 2, 2	0	1. 260 1. 260 1. 260	1. 270 1. 270 1. 270	1. 260 1. 260 1. 260	1. 260 1. 280 1. 280			
27	Trk, 2½ T 4 x 2 dump, 4109937.	4-H	C	2, 2, 2	0	1. 260 1. 260 1. 260	1. 240 1. 240 1. 240	1. 200 1. 200 1. 200	1. 280 1. 280 1. 280			

28	Trk, 2½ T 4 x 2 dump, 4110213.	4–H	C	2, 2, 2	0	1. 240 1. 240 1. 240	1. 260 1. 260 1. 260	1. 260 1. 240 1. 240	1. 260 1. 240 1. 240			
29	Trk, 1½ T 4 x 2 stake, 366967.	2–H	C	2, 2, 2	0	1. 280 1. 280 1. 260	1. 280 1. 260 1. 260	1. 270 1. 270 1. 270	1. 260 1. 260 1. 280			
30	Trk, 1½ T 4 x 2 stake, 3280410.	2–H	C	2, 2, 2	0	1. 280 1. 280 1. 280	1. 280 1. 280 1. 280	1. 280 1. 260 1. 280				Do.
31	Sedan (Chev.), 143169	1–M	D	2, 2, 2	0	1. 260 1. 270 1. 270	1. 260 1. 270 1. 260	1. 280 1. 280 1. 280	1. 260 1. 260 1. 280			
32	Trk, 4 x 2 carryall, 295519	2–H	D	2, 2, 2	0	1. 280 1. 280 1. 280	1. 280 1. 280 1. 270	1. 260 1. 260 1. 260	1. 240 1. 260 1. 240			
33	Trk, ½ T 4 x 2, 244941	1–M	D	2, 2, 2	0	1. 270 1. 270 1. 270	1. 270 1. 270 1. 270	1. 270 1. 270 1. 270	1. 270 1. 270 1. 270			
34	Trk, ½ T 4 x 2, 243269	M–1	D	2, 2, 2	0	1. 260 1. 260 1. 260	1. 280 1. 280 1. 280	1. 280 1. 280 1. 280	1. 280 1. 280 1. 280			
35	Trk, ½ T 4 x 2, 2269304	2–H	D	2, 2, 2	0	1. 260 1. 260 1. 260	1. 240 1. 240 1. 240	1. 220 1. 220 1. 220	1. 240 1. 240 1. 220			
36	Trk, ½ T 4 x 2, 298440	2–H	D	2, 2, 2	0	1. 240 1. 240 1. 240	1. 260 1. 260 1. 260	1. 260 1. 260 1. 260	1. 250 1. 250 1. 250			
37	Trk, 2½ T 4 x 2 dump, 492653.	4–H	D	2, 2, 2	0	1. 280 1. 260 1. 260	1. 280 1. 280 1. 280	1. 280 1. 280 1. 280	1. 290 1. 290 1. 270			
38	Trk, 2½ T 4 x 2 dump, 4106307.	4–H	D	2, 2, 2	0	1. 260 1. 260 1. 260	1. 280 1. 280 1. 280	1. 280 1. 280 1. 280	1. 260 1. 270 1. 260			
39	Trk, 1½ T 4 x 2 stake, 67378	2–H	D	2, 2, 2	0	1. 240 1. 240 1. 240	1. 270 1. 260 1. 260	1. 240 1. 240 1. 240	1. 260 1. 240 1. 240			
40	Trk, 1½ T 4 x 2 stake, 366966	2–H	D	2, 2, 2	0	1. 280 1. 280 1. 280	1. 260 1. 260 1. 260	1. 270 1. 270 1. 270	1. 280 1. 300 1. 260			

Explanatory notes: Tests for batteries for vehicles on Line 7, 11, 12, 13, 21, and 30 (in shop for repairs) will resume upon completion of repairs.

NOVEMBER 3, 1948.

Subject: Report on field service test of transport vehicle batteries containing Protecto-Charge.

To: Chief of Ordnance, Department of the Army, Washington 25, D. C.
(Attention: ORDFM–Auto.)

Enclosed is subject report for month of October forwarded in compliance with your letter, subject as above, dated August 9, 1948, file: 00 412.4/877.

RAY O. WELCH,
Colonel, Ordnance Department, Commanding.

One enclosure, report (in duplicate).

Line No.	Vehicle nomenclature and United States registry No.	Battery type: Standard nomenclature	Battery type: Type, A, B, C, D	Voltage reading from test	Number of times battery received charge this month	Specific gravity: 1st week	2d week	3d week	4th week	5th week	Date battery was removed	Remarks
1	Ply. Sedan, 142852	M–1	A									Deadlined for parts.
2	Trk, ¼ T 4 x 4, 20708755	2–H	A	(1) 2, 2				1.300	1.280			Reading picked up on return from shop.
				(2) 2, 2				1.280	1.280			
				(3) 2, 2				1.280	1.280			
3	Trk, ½ T 4 x 2, pickup, 256630.	2–H	A	(1) 2, 2, 2, 2		1.180	1.260	1.290	1.290			
				(2) 2, 2, 2, 2		1.180	1.260	1.290	1.290			
				(3) 2, 2, 2, 2		1.180	1.260	1.290	1.290			
4	Trk, ½ T 4 x 2, 256962	2–H	A	(1) 2		1.280						In shop for major repairs.
				(2) 2		1.240						
				(3) 2		1.280						
5	Trk, ½ T 4 x 2, 255064	2–H	A	(1) 2, 2, 2, 2		1.220	1.220	1.220	1.220			
				(2) 2, 2, 2, 2		1.220	1.200	1.220	1.260			
				(3) 2, 2, 2, 2		1.170	1.180	1.100	1.200			
6	Trk, 2½ T 4 x 2, dump, 4453006.	4–H	A	(1) 2, 2, 2, 2		1.260	1.250	1.200	1.260			
				(2) 2, 2, 2, 2		1.260	1.270	1.270	1.270			
				(3) 2, 2, 2, 2		1.620	1.250	1.260	1.260			
7	Trk, 1½ T 4 x 2, stake, 3146144.	2–H	A	(1) 2, 2		1.250	1.270					Do.
				(2) 2, 2		1.250	1.270					
				(3) 2, 2		1.250	1.270					
8	Trk, 1½ T 4 x 2, stake, 367419.	2–H	A	(1) 1, 9, 2, 2		1.100	1.260	1.210				Deadlined for parts.
				(2) 1, 9, 2, 1, 9		1.100	1.250	1.190				
				(3) 1, 9, 2, 2		1.100	1.280	1.210				
9	Trk, 2½ T 4 x 2 dump, 571552.[1]	4–H	A	(1) 2, 2, 2		1.270	1.250	1. 40				Do.
				(2) 2, 2, 2		1.270	1.250	1.240				
				(3) 2, 2, 2		1.270	1.250	1.240				
10	Trk, 2½ T 4 x 2 dump, 571552.[1]	4–H	A	(4) 2, 2, 2		1.270	1.260	1.300				
				(5) 2, 2, 2		1.270	1.260	1.290				
				(6) 2, 2, 2		1.270	1.260	1.260				
11	Sedan (Chev.), 142614	M–1	B	(1) 2, 2				1.270	1.250			Reading picked up on return from shop.
				(2) 2, 2				1.270	1.230			
				(3) 2, 2				1.270	1.280			
12	Trk, ¼ T 4 x 4, 20302591	2–H	B									Battery pulled. Fails to maintain charge on radio equipment patrol. Report on condition next month.
13	Trk, ¼ T 4 x 2, 2200208	M–1	B									In shop for major repairs.
14	Trk, ½ T 4 x 2, 255172	2–H	B	(1) 2, 2, 2			1.280	1.280	1.280			Do.
				(2) 2, 2, 2			1.280	1.280	1.280			
				(3) 2, 2, 2			1.280	1.280	1.280			

[1] Corrected.

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
15	Trk, ½ T 4 x 2, 255162	2-H	B	(1) 2, 2, 2, 2		1.250	1.260	1.280	1.260			In shop for major repairs.
				(2) 2, 2, 2, 2		1.250	1.260	1.280	1.260			
				(3) 2, 2, 2, 2		1.250	1.260	1.280	1.260			
16	Trk, 2½ T 4 x 2, 4453001	4-H	B	(1) 2, 2, 2	Charge 6 Oct.		1.280	1.230	1.280			
				(2) 2, 2, 2			1.280	1.270	1.280			
				(3) 2, 2, 2			1.280	1.270	1.250			
17	Trk, 1½ T 4 x 2, stake 367379.	2-H	B	(1) 2, 2, 2, 2			1.280	1.290	1.280	1.290		
				(2) 2, 2, 2, 2			1.280	1.290	1.280	1.290		
				(3) 2, 2, 2, 2			1.280	1.290	1.280	1.300		
18	Trk, 1½ T 4 x 2, 367373	2-H	B	(1) 2, 2, 2			1.280	1.200	1.200			Do.
				(2) 2, 2, 2			1.280	1.220	1.200			
				(3) 2, 2, 2			1.280	1.190	1.200			
19	Trk, 2½ T 4 x 2, tractor 571548.[1]	4-H	B	(1) 2, 2, 2, 2			1.280	1.280	1.270	1.260		
				(2) 2, 2, 2, 2			1.280	1.280	1.270	1.260		
				(3) 2, 2, 2, 2			1.280	1.280	1.270	1.260		
20	Trk, 2½ T 4 x 2, tractor 571548.[1]	4-H	B	(4) 2, 2, 2, 2			1.280	1.280	1.270	1.240		
				(5) 2, 2, 2, 2			1.280	1.280	1.270	1.240		
				(6) 2, 2, 2, 2			1.280	1.280	1.260	1.240		
21	Sedan (Ply.)	M–1	C									Do.
22	Trk, ¼ T 4 x 4, 20304108	2-H	C	(1) 2, 2, 2			1.270	1.280	1.280			Do.
				(2) 2, 2, 2			1.270	1.280	1.290			
				(3) 2, 2, 2			1.270	1.280	1.290			
23	Trk, ½ T 4 x 2, 244359	2-H	C	(1) 2, 2, 2			1.280	1.280	1.270			Do.
				(2) 2, 2, 2			1.280	1.280	1.270			
				(3) 2, 2, 2			1.280	1.280	1.270			
24	Trk, ½ T 4 x 2, 295785	M–1	C	(1) 2, 2, 2, 2			1.280	1.300	1.300	1.300		
				(2) 2, 2, 2, 2			1.280	1.300	1.300	1.300		
				(3) 2, 2, 2, 2			1.280	1.300	1.280	1.300		
25	Trk, ½ T 4 x 2, 2267031	M–1	C	(1) 2, 2, 2			1.280	1.280	1.270			Do.
				(2) 2, 2, 2			1.280	1.280	1.270			
				(3) 2, 2, 2			1.280	1.280	1.270			
26	Trk, ½ T 4 x 2, 296953	2-H	C	(1) 2, 2, 2			1.260	1.260	1.250			Do.
				(2) 2, 2, 2			1.260	1.260	1.250			
				(3) 2, 2, 2			1.260	1.260	1.250			
27	Trk, 2½ T 4 x 2, dump 4109937.	4-H	C	(1) 2, 2, 2			1.280	1.250	1.250			Do.
				(2) 2, 2, 2			1.280	1.250	1.250			
				(3) 2, 2, 2			1.280	1.250	1.250			
28	Trk, 2½ T 4 x 2, dump 4110213.	4-H	C	(1) 2, 2, 2, 2			1.120	1.240	1.280	1.280		
				(2) 2, 2, 2, 2			1.120	1.230	1.280	1.280		
				(3) 2, 2, 2, 2			1.120	1.250	1.280	1.280		

29	Trk, 1½ T 4 x 2, stake 366937.	2–H	C	(1) 2, 2, 2, 2			1.280	1.300	1.300	1.300	
				(2) 2, 2, 2, 2			1.280	1.290	1.300	1.300	
				(3) 2, 2, 2, 2			1.280	1.290	1.300	1.300	
30	Trk, 1½ T 4 x 2, stake 3280410.	2–H	C	(1) 2, 2, 2, 2			1.280	1.280	1.280	1.270	
				(2) 2, 2, 2, 2			1.280	1.270	1.270	1.270	
				(3) 2, 2, 2, 2			1.280	1.270	1.280	1.290	
31	Sedan (Chev.), 143169	M–1	D	(1) 2, 2, 2, 2			1.280	1.270	1.260	1.290	
				(2) 2, 2, 2, 2			1.280	1.280	1.200	1.290	
				(3) 2, 2, 2, 2			1.280	1.270	1.260	1.290	
32	Trk, 4 x 2 carryall, 295319	2–H	D	(1) 2					1.260		Deadlined. Reading picked up from return to service.
				(2) 2					1.260		
				(3) 2					1.250		
33	Trk, ½ T 4 x 2, 244941	M–1	D	(1) 2, 2, 2, 2		1.270	1.260	1.270	1.270		
				(2) 2, 2, 2, 2		1.270	1.260	1.270	1.270		
				(3) 2, 2, 2, 2		1.270	1.260	1.270	1.270		
34	Trk, ½ T 4 x 2, 243269	M–1	D	(1) 2, 2, 2, 2		1.270	1.250	1.240	1.240		
				(2) 2, 2, 2, 2		1.270	1.250	1.240	1.240		
				(3) 2, 2, 2, 2		1.270	1.250	1.240	1.240		
35	Trk, ½ T 4 x 2, 2269304	2–H	D	(1) 2, 2	Charge	1.280		1.280	1.280		
				(2) 2, 2	Oct. 10	1.280		1.280	1.280		
				(3) 2, 2, 2		1.280		1.280	1.280		
36	Trk, ½ T 4 x 2, 298440	2–H	D	(1) 2, 2, 2, 2		1.280	1.240	1.260	1.240		
				(2) 2, 2, 2, 2		1.280	1.250	1.260	1.240		
				(3) 2, 2, 2, 2		1.280	1.230	1.240	1.240		
37	Trk, 2½ T 4 x 2, dump 492653.	4–H	D	(1) 2, 2, 2, 2		1.260	1.270	1.260	1.240		
				(2) 2, 2, 2, 2		1.260	1.270	1.260	1.160		
				(3) 2, 2, 2, 2		1.260	1.270	1.250	1.240		
38	Trk, 2½ T 4 x 2, dump 4109307.	4–H	D	(1) 2, 2, 2		1.250	1.240	1.250			In shop.
				(2) 2, 2, 2		1.250	1.250	1.250			
				(3) 2, 2, 2		1.250	1.250	1.250			
39	Trk, 1½ T 4 x 2 stake, 367378.	2–H	D	(1) 2, 2, 2, 2		1.260	1.260	1.220	1.240		
				(2) 2, 2, 2, 2		1.260	1.260	1.220	1.240		
				(3) 2, 2, 2, 2		1.260	1.260	1.220	1.240		
40	Trk, 1½ T 4 x 2 stake, 366966.	2–H	D	(1) 2, 2, 2		1.260	1.250	1.250			In shop for major repairs.
				(2) 2, 2, 2		1.260	1.250	1.250			
				(2) 2, 2, 2		1.260	1.260	1.260			

[1] Corrected.

EXPLANATORY NOTES:

Battery No. 12. Report will be rendered next month on condition. All readings are from positive to negative terminals. Readings on vehicles in shop for repairs will begin when vehicle is returned to motor pool.

DECEMBER 3, 1948.

Subject: Report on field service test of transport vehicle batteries containing Protecto-Charge.

To: Chief of Ordnance, Department of the Army, Washington 25, D. C.
(Attention: ORDFM–Auto.)

Enclosed is subject report for month of November forwarded in compliance with your letter, subject as above, dated August 9, 1948, file: 00 412.4/877.

ROY O. WELCH,
Colonel, Ordnance Department, Commanding.

One enclosure report (in duplicate).

Line number	Vehicle nomenclature and United States registration number	Battery type: Standard nomenclature	Battery type: Type, A, B, C, D	Voltage reading from test	Number of times battery received charge this month	Specific gravity: 1st week	2d week	3d week	4th week	5th week	Date battery was removed	Remarks
1	Ply. Sedan, 142852	M–1	A								Oct. 6, 1948	See explanatory notes (battery A1).
2	Trk, ¼ T 4 x 4, 20708755	2–H	A	(1) 2, 2, 2, 2		1.280	1.280	1.260	1.280			
				(2) 2, 2, 2, 2		1.280	1.280	1.260	1.280			
				(3) 2, 2, 2, 2		1.280	1.280	1.260	1.280			
3	Trk, ½ T 4 x 2, pickup 256630	2–H	A	(1) 2, 2, 2, 2		1.280	1.280	1.280	1.280			
				(2) 2, 2.1, 2, 2.1		1.280	1.290	1.280	1.280			
				(3) 2, 2.1, 2, 2.1		1.280	1.270	1.280	1.280			
4	Trk, ½ T 4 x 2, 256962	2–H	A	(1) 2, 2, 2, 2		1.260	1.260	1.260	1.260			
				(2) 2, 2, 2, 2		1.240	1.260	1.250	1.240			
				(3) 2, 2, 2, 2		1.280	1.260	1.260	1.280			
5	Trk, ½ T 4 x 2	2–H	A	(1) 2.1, 2.0, 2, 2		1.200	1.200	1.200	1.200		Nov. 29, 1948	Dead cell. Will report next month.
				(2) 2.1, 2.1, 2, 2		1.200	1.200	1.200	1.200			
				(3) 2.2, 2.1, 2, 1.5		1.200	1.200	1.150	1.000			
6	Trk, 2½ T 4 x 2, dump 4453006	4–H	A	(1) 1.9, 2, 2.2, 2.2		1.260	0.260	1.260	1.260			
				(2) 2, 2, 2.1, 2.1		1.260	1.270	1.200	1.280			
				(3) 2, 2, 2, 2		1.260	1.280	1.280	1.280			
7	Trk, 1½ T 4 x 2, stake 3146144	–H	A	(1) 2.1, 2.1, 2		1.300	1.300	1.300				In shop for major repairs.
				(2) 2.1, 2.1, 2		1.300	1.300	1.300				
				(3) 2.2, 2.1, 2		1.300	1.300	1.300				
8	Trk, 1½ T, 4 x 2, stake 367419	2–H	A	(1) 2.1, 2.1, 2, 2.1		1.260	1.220	1.220	1.240			
				(2) 2.1, 2.1, 2, 2.1		1.270	1.220	1.250	1.250			
				(3) 2, 2.1, 2, 2.1		1.280	1.280	1.280	1.260			
9	Trk, 2½ T 4 x 2, 571552	4–H	A	(1) 2.2, 2.2, 2.1, 2.1		1.270	1.270	1.280	1.280			
				(2) 2.2, 2.2, 2.1, 2.1		1.270	1.270	1.280	1.280			
				(3) 2.2, 2.2, 2.1, 2.1		1.270	1.270	1.280	1.280			
10	Trk, 2½ T 4 x 2	4–H	A	(1) 2.2, 2.2, 2.1, 2.2		1.280	1.280	1.280	1.280			
				(2) 2.2, 2.2, 2.1, 2.2		1.290	1.280	1.280	1.280			
				(3) 2.2, 2.2, 2.1, 2.2		1.280	1.280	1.280	1.280			
11	Sedan (Chev.) 1, 42614	M–1	B	(1) 2, 2, 2, 2		1.270	1.270	1.280	1.270			
				(2) 2, 2, 2, 2		1.280	1.280	1.280	1.280			
				(3) 2, 2, 2, 2.1		1.280	1.280	1.280	1.280			
12	Trk, ¼ T 4 x 4, 20302591	2–H	B									Battery withdrawn. See explanatory notes (battery B–12).
13	Trk, ½ T 4 x 2, 2200298	M–1	B	(1) 2, 2, 2, 2		1.280	1.280	1.250	1.250			
				(2) 2, 1.5, 2, 1.5		1.260	1.260	1.280	1.260			
				(3) 2, 2, 2, 2		1.280	1.280	1.280	1.280			
14	Trk, ½ T 4 x 2, 255172	2–H	B									In shop for major repairs.
15	Trk, ½ T 4 x 2, 255162	2–H	B	(1) 2, 2, 2.1, 2		1.280	1.280	1.280	1.280			
				(2) 2, 2, 2.2, 2		1.280	1.280	1.300	1.200			
				(3) 2, 2, 2.2, 2		1.280	1.280	1.280	1.270			

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
16	Trk, 2½ T 4 x 2, 4453001	4–H	B	(1) 2.1, 2, 2.1, 2.1		1.280	1.280	1.300	1.290			
				(2) 2.1, 2, 2.1, 2.1		1.280	1.280	1.280	1.280			
				(3) 2.1, 2, 2.1, 2.1		1.280	1.280	1.280	1.280			
17	Trk, 1½ T 4 x 2, 367379	2–H	B	(1) 2, 2, 2.1, 2		1.280	1.290	1.290	1.240			
				(2) 2, 2, 2.1, 2		1.280	1.290	1.290	1.240			
				(3) 2, 2, 2.1, 2		1.280	1.290	1.290	1.240			
18	Trk, 1½ T 4 x 2, 367373	2–H	B	(1) 2.1, 2, 2, 2		1.250	1.240	1.240	1.280			
				(2) 2.1, 2, 2, 2		1.260	1.240	1.240	1.280			
				(3) 2.1, 2, 2, 2		1.260	1.240	1.240	1.270			
19	Trk, 2½ T 4 x 2, 571548	4–H	B	(1) 2.1, 2, 2, 2		1.280	1.250	1.240	1.250			
				(2) 2.1, 2, 2, 2		1.260	1.250	1.240	1.250			
				(3) 2.1, 2, 2, 2		1.260	1.250	1.240	1.250			
20	Trk, 2½ T 4 x 2, 571548	4–H	B	(1) 2.1, 2, 2, 2		1.260	1.250	1.240	1.170			
				(2) 2.1, 2, 2, 2		1.260	1.250	1.240	1.200			
				(3) 2.1, 2, 2, 2		1.270	1.250	1.240	1.200			
21	Sedan (Ply.), 141835	M–1	C	(1) 2, 2, 2, 2		1.270	1.180	1.240	1.280			
				(2) 2, 2, 2, 2		1.270	1.280	1.240	1.280			
				(3) 2, 2, 2, 2		1.270	1.280	1.240	1.280			
22	Trk, ¼ T 4 x 4, 20304108	2–H	C	(1) 2.2, 2.2, 2.2, 2		1.280	1.280	1.280	1.260			
				(2) 2.2, 2.2, 2.2, 2		1.280	1.280	1.280	1.260			
				(3) 2.2, 2.2, 2.2, 2		1.280	1.280	1.280	1.260			
23	Trk, ½ T 4 x 2, 244359	2–H	C	(1) 2, 2, 2, 2		1.280	1.280	1.280	1.280			
				(2) 2, 2, 2, 2		1.280	1.280	1.280	1.280			
				(3) 2, 2, 2, 2		1.280	1.280	1.280	1.280			
24	Trk, ½ T 4 x 2, 295785	M–1	C	(1) 2.1, 2, 2.1, 2.1		1.260	1.190	1.300	1.300			
				(2) 2.1, 2, 2.1, 2.1		1.260	1.190	1.280	1.300			
				(3) 2.1, 2, 2.1, 2.1		1.260	1.190	1.280	1.300			
25	Trk, ½ T 4 x 2, 2267031	M–1	C									In shop for major repairs.
26	Trk, ½ T 4 x 2, 296953	2–H	C									Do.
27	Trk, 2½ T 4 x 2, dump 4109937.	4–H	C	(1) 1.2, 2, 2	Charge Nov. 10	1.180		1.280	1.280			
				(2) 1.2, 2, 2		1.180		1.280	1.280			
				(3) 1.2, 2, 2		1.180		1.280	1.280			
28	Trk, 2½ T 4 x 2, 4110213	4–H	C	(1) 2, 2, 2, 2		1.280	1.250	1.280	1.280			
				(2) 2, 2, 2, 2		1.280	1.250	1.280	1.280			
				(3) 2, 2, 2, 2		1.280	1.280	1.280	1.280			
29	Trk, 1½ T 4 x 2, 366937	2–H	C	(1) 2, 2, 2, 2		1.300	1.300	1.300	1.280			
				(2) 2, 2, 2, 2		1.300	1.300	1.300	1.280			
				(3) 2, 2, 2, 2		1.300	1.300	1.300	1.280			
30	Trk, 1½ T 4 x 2, 3280410	2–H	C	(1) 2.1, 2, 2, 2		1.300	1.280	1.280	1.280			
				(2) 2.1, 2, 2, 2		1.300	1.280	1.280	1.280			
				(3) 2.1, 2, 2, 2		1.300	1.280	1.280	1.280			

31	Sedan (Chev.), 143169	M–1	D	(1) 2, 2.1, 2, 2.1		1.260	1.280	1.280	1.280	
				(2) 2, 2.1, 2, 2.1		1.260	1.280	1.280	1.280	
				(3) 2, 2.1, 2, 2.1		1.260	1.280	1.280	1.280	
32	Carryall, 4 x 2, 295319	2–H	D							Deadlined to shop for repairs.
33	Trk, ½ T 4 x 2, 244941	M–1	D							In shop for repairs.
34	Trk, ½ T 4 x 2, 243268	M–1	D	(1) 2, 2, 2, 2		1.250	1.250	1.260	2.180	
				(2) 2, 2, 2, 2		1.250	1.250	1.260	1.300	
				(3) 2, 2, 2, 2		1.250	1.250	1.260	1.300	
35	Trk, ½ T 4 x 2, 2260304	2–H	D	(1) 2, 2, 2, 2		1.260	1.270	1.280	1.270	
				(2) 2, 2, 2.1, 2		1.270	1.270	1.280	1.270	
				(3) 2, 2, 2.1, 2		1.270	1.270	1.280	1.270	
36	Trk, ½ T 4 x 2, 298440	2–H	D	(1) 1.9, 2, 2, 2		1.200	1.210	1.220	1.250	
				(2) 1.9, 2, 2, 2		1.200	1.210	1.240	1.250	
				(3) 1.9, 2, 2.1, 2		1.200	1.210	1.240	1.250	
37	Trk, 2½ T 4 x 2 dump, 492653.	4–H	D	(1) 2, 2, 2.1, 2.1		1.160	1.240	1.260	1.260	
				(2) 2, 2, 2.1, 2.2		1.160	1.240	1.260	1.280	
				(3) 2, 2.1, 2.1, 2.1		1.160	1.240	1.260	1.280	
38	Trk, 2½ T 4 x 2 dump, 4100307.	4–H	D	(1) 2, 2, 2, 2		1.280	1.280	1.270	1.260	
				(2) 2, 2, 2, 2		1.280	1.280	1.270	1.260	
				(3) 2, 2, 2, 2		1.280	1.280	1.270	1.260	
39	Trk, 1½ T 4 x 2, 367378	2–H	D	(1) 2, 2, 2, 2		1.220	1.220	1.230	1.220	
				(2) 2, 2, 2, 2		1.220	1.220	1.240	1.220	
				(3) 2, 2, 2, 2		1.220	1.220	1.240	1.220	
40	Trk, 1½ T 4 x 2 stake, 366966	2–H	D							In shop for major repairs.

EXPLANATORY NOTES

Battery No. A 1 (withdrawn Oct. 6, 1948)—

Report:

(*a*) Generator charging rate was 15 amperes at 7.5 volts.
(*b*) Gravity reading when battery failed—0.
(*c*) All cells indicated negative voltage reading.
(*d*) Sediment in 1 quart jar was ¾ inch.
(*e*) Type separators were wood.
(*f*) Remarks:
(1) When cells were removed positive plates were broken up crumbled.
(2) No sulfation was shown on negative plates and plates were in good condition.
(3) Separators were also in good condition.
(4) Battery was manufactured in 1944. 1 cell indicates having been repaired.

Battery No. B 12 (withdrawn Oct. 6, 1948)—

Report:

(*a*) Generator charging rate was 30 amperes with 85 volts.
(*b*) Gravity when battery failed—1100.
(*c*) All cells showed a voltage reading of 1 volt.
(*d*) Sediment in 1 quart jar was 5/8 inch.
(*e*) Type of separators were wood.
(*f*) Remarks:
(1) Positive plates were deteriorated beyond future use and indicate having been frozen at one time.
(2) No sulfation showed on negative plates.
(3) Negative plates were in good condition.
(4) Separators were in good condition.
(5) Battery was manufactured in 1943 and shows no evidence of having been repaired (straps still have original stamps).

FEBRUARY 7, 1949.

Subject: Report on field service test of transport vehicle batteries containing Protecto-Charge.

To: Chief of Ordnance,
Department of the Army,
Washington 25, D. C.
(Attention: ORDFM–Auto.)

Enclosed is subject report for month of January forwarded in compliance with your letter, subject as above, dated August 9, 1948, file: 00 412.4/877.

RAY O. WELCH,
Colonel, Ordnance Department, Commanding.

1 enclosure, report (in duplicate).

Line No.	Vehicle nomenclature and United States registry No.	Battery type: Standard nomenclature	Battery type: Type, A, B, C, D	Voltage reading from test	Number of times battery received charge this month	Specific gravity: 1st week	2d week	3d week	4th week	5th week	Date battery was removed	Remarks
1	Plymouth sedan, 142852	M-1	A								Oct. 6, 1948	Withdrawn (October).
2	Trk, ¼ T 4 x 4, 20706755	2-H	A	(1) 2, 2, 2			1.280	1.260	1.250			
				(2) 2, 2, 2			1.280	1.260	1.250			
				(3) 2, 2, 2			1.270	1.250	1.240			
3	Trk, ½ T 4 x 2, 256630	2-H	A	(1) 2, 2, 2.2, 2.2		1.240	1.260	1.280	1.240			
				(2) 2, 2, 2 2, 2.2		1.240	1.270	1.300	1.290			
				(3) 2, 2, 2.2, 2.2		1.240	1.260	1.280	1.280			
4	Trk, ½ T 4 x 2, 256963	2-H	A	(1) 2, 2, 2.1, 2.1		1.240	1.280	1.280	1.300			
				(2) 2.1, 2, 2, 2.1		1.260	1.260	1.280	1.300			
				(3) 2.2, 2, 2, 2.1		1.300	1.300	1.300	1.200			
5	Trk, ½ T 4 x 2, 255064	2-H	A	(1)								Withdrawn.
				(2)								
				(3)								
6	Trk, 2½ T 4 x 2, 4453006	4-H	A	(1) 2, 2, 2.2, 2		1.260	1.300	1.270	1.260			
				(2) 2.3, 2.3, 2, 2		1.260	1.300	1.280	1.290			
				(3) 2, 2.2, 2, 2		1.300	1.260	1.280	1.270			
7	Trk, 1½ T 4 x 2, 3146144	2-H	A	(1) 2, 2, 2		1.250	1.270	1.220	(1)			Withdrawn. (See explanatory notes.)
				(2) 2, 2, 2		1.250	1.260	1.220				
				(3) 2, 2, 2		1.250	1.260	1.240				
8	Trk, 1½ T 4 x 2, 367419	2-H	A	(1) 2, 2, 2, 2.1		1.280	1.280	1.270	1.270			
				(2) 2, 2, 2, 2		1.220	1.220	1.210	1.220			
				(3) 2, 2, 2, 2		1.250	1.220	1.220	1.220			
9	Trk, 2½ T 4 x 2, 571552	4-H	A	(1) 2.1, 2, 2, 2.1		1.260	1.260	1.260	1.260			
				(2) 2, 2, 2, 2		1.270	1.260	1.260	1.260			
				(3) 2.1, 2, 2, 2		1.290	1.260	1.260	1.260			
10	Trk, 2½ T 4 x 2, 571552	4-H	A	(1) 2, 2, 2, 2		1.250	1.280	1.280	1.280			
				(2) 2, 2, 2, 2		1.270	1.270	1.280	1.270			
				(3) 2, 2, 2, 2		1.300	1.290	1.260	1.260			
11	Sedan (Chevrolet), 142614	M-1	B	(1)		(1)					Nov. 22, 1948	Withdrawn. Report due.
12	Trk, ¼ T 4 x 4, 20302591	2-H	B								Oct. 6, 1948	Withdrawn (October).
13	Trk, ½ T 4 x 2, 2200298	M-1	B	(1) 2, 2, 1.9		1.240	1.230	1.200	(2)			
				(2) 2, 2, 1.9		1.240	1.240	1.200	(2)			
				(3) 2, 2, 1.8		1.250	1.240	1.180	(2)			
14	Trk, ½ T 4 x 2, 255172	2-H	B	(1) 2, 2, 1.9		(2)	1.300	1.300	1.240			
				(2) 2, 2, 2		6.000	1.300	1.300	1.260			
				(3) 2, 2, 2			1.280	1.280	1.260			
15	Trk, ½ T 4 x 2, 255126	2-H	B	(1) 2, 2, 2, 2		1.200	1.280	1.260	1.280			
				(2) 2, 2, 2, 2		1.260	1.270	1.280	1.280			
				(3) 2, 2, 2, 2		1.250	1.280	1.290	1.250			

[1] Dead. [2] Charge. [3] Shop.

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
16	Trk, 2½ T 4 x 2, 4453001	4-H	B	(1) 2, 2, 2, 2		1.240	1.240	1.240	1.240			
				(2) 2, 2, 2, 2.2		1.260	1.270	1.280	1.300			
				(3) 2, 2, 2, 2.1		1.260	1.270	1.280	1.280			
17	Trk, 1½ T 4 x 2, 367379	2-H	B	(1) 2, 2.1, 2, 2		1.250	1.260	1.290	1.290			
				(2) 2, 2.2, 2, 2		1.250	1.280	1.270	1.280			
				(3) 2, 2.1, 2, 2		1.250	1.280	1.280	1.280			
18	Trk, 1½ T 4 x 2, 367373	2-H	B	(1) 2, 2, 2, 2		1.260	1.190	1.180	1.180			
				(2) 2, 2, 2, 2		1.260	1.220	1.230	1.220			
				(3) 2, 2, 2, 2		1.260	1.200	(4)	1.220			
19	Trk, 2½ T 4 x 2, 371548	4-H	B	(1) 2, 2, 2, 2		1.210	1.220	1.240	1.260			
				(2) 2, 2, 2, 2		1.200	1.240	1.240	1.260			
				(3) 2, 2, 2, 2		1.200	1.230	1.240	1.260			
20	Trk, 2½ T 4 x 2, 371548	4-H	B	(1) 2, 2, 2, 2		1.240	1.260	1.250	1.240			
				(2) 2, 2, 2, 2		1.240	1.270	1.240	1.220			
				(3) 2, 2, 2, 2		1.240	1.240	1.220	1.220			
21	Sedan (Plymouth), 141835	M-1	C	(1) 2, 2, 2, 2		1.240	1.240	1.240	1.220			
				(2) 2, 2, 2, 2		1.260	1.260	1.240	1.230			
				(3) 2, 2, 2, 2		1.240	1.240	1.230	1.220			
22	Trk, ¼ T 4 x 4, 20304108	2-H	C	(1) 2, 2, 2, 2		1.260	1.270	1.260	1.260			
				(2) 2, 2, 2, 2		1.260	1.270	1.250	1.260			
				(3) 2, 2, 2, 2		1.260	1.270	1.250	1.260			
23	Trk, ½ T 4 x 2, 244359	2-H	C	(1) 2, 2, 2, 2		1.260	1.270	1.270	1.260			
				(2) 2, 2, 2, 2		1.260	1.270	1.270	1.260			
				(3) 2, 2, 2, 2		1.260	1.260	1.270	1.240			
24	Trk, ½ T 4 x 2, 295785	M-1	C	(1) 2, 2, 2.1, 2.2		1.300	1.300	1.280	1.300			
				(2) 2, 2, 2.2, 2.2		1.280	1.280	1.300	1.300			
				(3) 2, 2, 2.1, 2.2		1.300	1.300	1.300	1.300			
25	Trk, ½ T 4 x 2, 2267031	M-1	C	(1) 2, 2, 2		(3)	1.250	1.240	1.230			
				(2) 2, 2, 2		6.000	1.240	1.240	1.230			
				(3) 1.9, 2, 1.9			1.220	1.220	1.220			
26	Trk, ½ T 4 x 2, 296058	2-H	C	(1) 2, 1.9, 2, 2		1.240	1.200	1.240	1.250			
				(2) 2, 2, 2, 2		1.250	1.220	1.250	1.260			
				(3) 2, 2, 2, 2		1.270	1.240	1.260	1.280			
27	Trk, 2½ T 4 x 2, 4100937	4-H	C	(1) 2, 2, 2, 2.1		1.250	1.210	1.220	1.240			
				(2) 2, 2, 2, 2		1.250	1.190	1.190	1.200			
				(3) 2, 2, 1.9, 1.9		1.260	1.200	1.200	1.210			
28	Trk, 2¾ ton 4 x 2, 4110213	4-H	C	(1) 2, 2, 2, 2, 2		1.260	1.240	1.240	1.240			
				(2) 2, 2, 2, 2, 2		1.260	1.230	1.230	1.260			
				(3) 2, 2, 2, 2, 2		1.260	1.240	1.230	1.240			
29	Trk, 1½ ton 4 x 2, 366967	2-H	C	(1) 2, 2, 2		1.270	1.280	1.260	(1)			Withdrawn.
				(2) 2, 2, 2		1.260	1.280	1.260	(1)			
				(3) 2, 2, 2		1.270	1.300	1.260	(1)			

				(3) 2, 2, 2		1.260	1.300	1.260	(1)			Withdrawn.
30	Trk, 1½ ton 4 x 2, 3280410	2–H	C	(1) 2, 2, 2, 2		1.280	1.280	1.280	1.280			
				(2) 2, 2, 2, 2		1.280	1.280	1.280	1.280			
				(3) 2, 2, 2, 2		1.280	1.280	1.280	1.280			
31	Sedan (Chev.), 143169	M–1	D	(1) 2, 2		1.270	1.270					D. S. W/CO Jan. 21, 1949.
				(2) 2, 2		1.280	1.280					
				(3) 2, 2		1.270	1.270					
32	Carryall, 4 x 2, 295319	2–H	D	(1) 2, 2, 2, 1.9		1.150	1.150	1.130	1.130			Radio patrol car.
				(2) 2, 2, 2, 1.9		1.150	1.150	1.120	1.120			
				(3) 2, 2, 2, 1.9		1.150	1.150	1.120	1.120			
33	Trk, ½ ton 4 x 2, 244941	M–1	D	(1) 2, 2, 1.9, 1.9		1.220	1.200	1.200	1.150			
				(2) 2, 2, 1.9, 1.8		1.230	1.210	1.210	1.120			
				(3) 2, 2, 1.9, 1.9		1.230	1.210	1.210	1.130			
34	Trk, ½ ton 4 x 2, 243268	M–1	D	(1) 2, 2, 3, 2.2		1.250	1.290	(4)	1.290			
				(2) 2, 2, 2, 2.2		1.250	1.280	(4)	(4)			
				(3) 2, 2, 2, 2.2		1.250	1.270	(4)	(4)			
35	Trk, ½ ton 4 x 2, 2269304	2–H	D	(1)								Withdrawn. (See report.)
36	Trk., ½ T., 4 x 2, 298440	2–H	D	(1) 2, 2, 2, 2		1.260	1.280	1.290	1.260			
				(2) 2, 2, 2, 2		1.250	1.260	1.290	1.240			
				(3) 2, 2, 2, 2		1.250	1.280	1.290	1.240			
37	Trk., 2½ T., 4 x 2, 492653	4–H	D	(1) 2, 2, 2.2, 2.2		1.290	1.280	1.300	1.300			
				(2) 2, 2, 2, 2.1		1.290	(4)	1.270	1.280			
				(3) 2, 2, 2, 2.2		1.290	(4)	1.280	1.290			
38	Trk., 2½ T., 4 x 2, 4109307	4–H	D	(1) 2, 2, 2, 2		1.290	1.250	1.280	1.280			
				(2) 2, 2, 2, 2		1.300	1.260	1.280	1.300			
				(3) 2, 2, 2, 2		1.300	1.240	1.280	1.300			
39	Trk., 1½ T., 4 x 2, 367378	2–H	D	(1) 2, 2, 2, 2.1		1.250	1.240	1.340	1.300			
				(2) 2, 2, 2, 2.1		1.250	1.220	1.240	1.300			
				(3) 2, 2, 2, 2.1		1.250	1.220	1.210	1.300			
40	Trk., 1½ T., 4 x 2, 366966	2–H	D	(1) 2, 2.2, 2, 2		1.290	1.300	(4)	1.260			
				(2) 2, 2.2, 2, 2		1.280	1.300	(4)	1.260			
				(3) 2, 2.2, 2, 2		1.290	1.300	(4)	1.280			

[1] Dead. [2] Charge. [3] Shop. [4] Dry.

EXPLANATORY NOTES

Battery No. A 7 withdrawn Jan. 3, 1949;
Report:
(a) Generator charging rate was 15 amperes at 6.5 volts.
(b) Gravity when battery failed was on—
No. 1 cell, no reading.
No. 2 cell, 1200.
No. 3 cell, 1220.
(c) No. 1 cell showed no volts; Nos. 2 and 3 cells with 2 and 2.1.
(d) Sediment in 1 quart jar was 7/8 inch.
(e) Type of separators were wood.
(f) Remarks:
(1) Positive plates were deteriorated beyond future use.
(2) No sulfation showed on positive or negative plates in all cells.
(3) Negative plates were in poor condition for further use.
(4) Separators were in fair condition.
(5) Date of manufacture could not be determined.

Battery B 11 withdrawn Nov. 22, 1948:
Report:
(a) Generator charging rate was 15 amperes at 6.5 volts.
(b) Gravity when battery failed, no reading.
(c) Voltage reading on all cells, 1 volt.
(d) Sediment in 1 quart jar was 3¼ inch.
(e) Type of separators were wood.
(f) Remarks:
(1) Positive were deteriorated beyond future use, most of them were broken up.
(2) No sulfation on either positive or negative plates.
(3) Negative plates were in bad condition.
(4) Separators were in bad condition.
(5) Date of manufacture could not be determined but indications showed that battery had never been rebuilt.

EXPLANATORY NOTES—Continued

Battery C 9 withdrawn Jan. 24, 1949:
Report:
(a) Generator charging rate was 15 amperes at 6.7 volts.
(b) Gravity when battery failed was on—
No. 1 cell with no reading.
No. 2 cell, 1240.
No. 3 cell, 1222.
(c) No. 1 cell showed no voltage; Nos. 2 and 3 cell read 2 volts.
(d) Sediment in 1 quart jar on No. 1 cell was 7/8 inch; Nos. 2 and 3 cell was 1/4 inch.
(e) Type separators were wood.
(f) Remarks:
(1) Positive plates on No. 1 cell were crumbled; Nos. 2 and 3 cells were in fair condition.
(2) No sulfation showed on positive or negative plates in all cells.
(3) Negative plates were in good condition for further use.
(4) Separators on No. 1 cell were in poor condition while Nos. 2 and 3 were in good condition.
(5) Date of manufacture could not be determined from markings on straps.

Battery D 5 withdrawn Dec. 27, 1948:
Report:
(a) Generator charging rate was 17 amperes at 7 volts.
(b) Gravity when battery failed was 1100 on all cells.
(c) Voltage reading was 1.-1.-0.
(d) Sediment in 1 quart jar was 5/8 inch on all cells.
(e) Type of separators were wood.
(f) Remarks:
(1) Positive plates on the No. 1 cell were crumbled and broken.
(2) No sulfation showed on positive or negative plates.
(3) Negative plates were in fair condition.
(4) Separators were in good condition.
(5) Date of manufacture could not be determined from markings on straps.
(6) It is believed that the plates were not formed properly, causing the above stated conditions.

MARCH 2, 1949.

Subject: Report on field service test of transport vehicle batteries containing Protecto-Charge.

To: Chief of Ordnance, Department of the Army, Washington 25, D. C.
(Attention: ORDFM-Auto.)

Enclosed is subject report for month of February forwarded in compliance with your letter, subject as above, dated August 9, 1948, file: 00 412.4/877.

RAY O WELCH,
Colonel, Ordnance Department, Commanding.

One enclosure, report (in duplicate.)

38414—53——44

Line No.	Vehicle nomenclature and United States registration No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type A, B, C, D			1st week	2d week	3d week	4th week	5th week		
1	Sedan (Plymouth), 142852	M–1	A	(1) 2.1, 2, 2		Charge	1.290	1.280	1.230			Withdrawn (October).
2	Trk, ¼ T 4 x 4, 20708755	2–H	A	(2) 2.1, 2, 2			1.290	1.280	1.250			
				(3) 2.1, 2, 2			1.280	1.270	1.260			
3	Trk, ½ T 4 x 2, 256630	2–H	A	(1) 2, 2, 2, 2.1		1.260	1.250	1.280	1.280			
				(2) 2, 2, 2, 2		1.280	Dry	1.260	1.260			
4	Trk, ½ T 4 x 2, 256962	2–H	A	(3) 2, 2, 2, 2		1.260	1.250	1.260	1.270			
				(1) 2.1, 2, 2, 2		1.290	1.290	1.250	1.260			
5	Trk, ½ T 4 x 2, 255064	2–H	A	(2) 2.1, 2, 2, 2		1.290	1.280	1.240	1.250			
6	Trk, 2½ T 4 x 2, 4453006	4–H	A	(3) 2.1, 2, 2, 2		1.290	1.290	1.240	1.250			
				(1) 2.1, 2, 2, 2.1		1.280	1.280	1.260	1.270			Withdrawn.
7	Trk, 1½ T 4 x 2, 3146144	2–H	A	(2) 2.2, 2, 2, 2		1.280	1.280	1.260	1.270			
8	Trk, 1½ T 4 x 2, 367419	2–H	A	(3) 2.2, 2, 2, 2		1.240	1.270	1.250	1.260			
				(1)								
				(1) 2, 2, 2.1, 2		1.270	1.270	1.280	1.280			Do.
9	Trk, 2½ T, 4 x 2, 571552	4–H	A	(2) 1.5, 2, 2, 2		1.220	1.220	1.260	1.250			
				(3) 2, 2, 2, 2		1.280	1.280	1.240	1.260			
				(1) 2, 2, 2, 2		1.250	1.250	1.250	1.250			
10	Trk, 2½ T, 4 x 2, 571552	4–H	A	(2) 2.2, 2, 2, 2		1.300	1.290	1.260	1.260			
				(3) 2.1, 2.1, 2, 2		1.280	1.280	1.260	1.260			
				(1) 2, 2, 2, 2.1		1.250	1.260	1.270	1.270			
11	Sedan (Chev.) 142614	M–1	B	(2) 2, 2.1, 2, 2		1.270	1.270	1.270	1.270			
12	Trk, ¼ T, 4 x 4, 20302591	2–H	B	(3) 2, 2.1, 2, 2.1		1.270	1.270	1.270	1.270			
13	Trk, ½ T, 4 x 2, 2.00.98	M–1	B									Withdrawn.
				(1) 1.5, 1.5, 1.5		Dry	1.170	1.170				Do.
14	Trk, ½ T, 4 x 2, 255172	2–H	B	(2) 1.5, 1.5, 1.5		1.170	1.170	1.170				Withdrawn (see explanatory remarks).
				(3) 1.5, 1.5, 0		1.170	1.160	Dead				
				(1) 2, 2, 2.1, 2		1.270	1.270	1.280	1.270			
15	Trk, ½ T, 4 x 2, 255126	2–H	B	(2) 2, 2, 2.1, 2		1.270	1.270	1.280	1.270			
				(3) 2, 2, 2.1, 2		1.250	1.260	1.270	1.260			
				(1) 2, 2, 2, 2		1.260	1.250	1.240	1.240			
16	Trk, 2½ T, 4 x 2, 4453001	4–H	B	(2) 2, 2, 2, 2.1		1.260	1.250	1.240	1.240			
				(3) 2.2, 2, 2, 2		1.250	1.240	1.200	1.210			
				(1) 2, 2, 2, 2		1.220	1.240	1.220	1.230			
17	Trk, 1½ T, 4 x 2, 367373	2–H	B	(2) 2, 2, 2.1, 2		1.220	1.260	1.240	1.230			
				(3) 2, 2, 2.1, 2.1		1.240	Dry	1.240	1.250			
				(1) 2, 2, 2, 2.1		1.250	1.260	1.270	1.280			
				(2) 2, 2, 2, 2		1.250	1.260	1.260	1.260			
				(3) 2, 2, 2, 2.1		1.250	1.250	1.260	1.280			

18	Trk, 1½ T, 4 x 2, 367373	2-H	B	(1) 2, 2, 2, 2		1.200	1.190	1.180	1.200	
				(2) 2, 2, 2, 2		1.220	1.230	1.220	1.220	
				(3) 2, 2, 2, 2.1		1.240	1.230	1.280	1.280	
19	Trk, 2½ T, 4 x 2, 571548	4-H	B	(1) 2, 2, 2, 2		1.180	1.220	1.220	1.220	
				(2) 2, 2, 2, 2		1.200	1.200	1.220	1.220	
				(3) 2, 2, 2, 2		1.200	1.220	1.220	1.220	
20	Trk, 2½ T, 4 x 2, 571548	4-H	B	(1) 2, 2, 2, 2		1.240	1.200	1.210	1.240	
				(2) 1.5, 2, 2, 2		1.220	1.190	1.200	1.240	
				(3) 2, 2, 2, 2		1.240	1.230	1.230	1.240	
21	Sedan (Plymouth), 141835	M-1	C	(1) 2, 2, 2, 2		1.220	1.240	1.220	1.250	
				(2) 2, 2, 2, 2		1.240	1.230	1.240	1.250	
				(3) 2, 2, 2, 2		1.220	1.240	1.240	1.250	
22	Trk, ½ T, 4 x 4, 20304108	2-H	C	(1) 2, 2, 2, 2		1.270	1.270	1.270	1.270	
				(2) 2, 2, 2, 2		1.260	1.270	1.270	1.270	
				(3) 2, 2, 2, 2		1.270	1.270	1.260	1.270	
23	Trk, ½ T, 4 x 2, 244359	2-H	C	(1) 2, 2, 2.1, 2.2		1.270	1.260	1.260	1.260	
				(2) 2, 2, 2, 2.2		1.270	1.250	1.240	1.240	
				(3) 2, 2, 2.1, 2.2		1.270	1.260	1.250	1.240	
24	Trk, ½ T, 4 x 2, 295785	M-1	C	(1) 2, 2, 2.1		1.250	1.260	1.270	1.280	
				(2) 2, 2, 2.2		1.250	1.270	1.290	1.300	
				(3) 2, 2.1, 2.2		1.260	1.290	1.300	1.300	
25	Trk, ½ T 4 x 2, 2267031	M-1	C	(1) 2, 2, 2, 2		1.300	1.300	Dry	1.290	
				(2) 2, 2, 2, 2		1.300	1.280	Dry	1.270	
				(3) 2, 2, 2, 2		1.300	1.280	Dry	1.270	
26	Trk, ½ T 4 x 2, 296953	2-H	C	(1) 1.8, 2, 2		1.150	Charge	1.260	1.260	
				(2) 1.9, 2, 2		1.150	-------	1.240	1.260	
				(3) 1.5, 2, 2		1.150	-------	1.260	1.260	
27	Trk, 2½ T 4 x 2, 4109937	4-H	C	(1) 2, 2, 2, 2		1.280	1.250	Dry	1.250	
				(2) 2, 2, 2, 2		1.280	1.240	Dry	1.240	
				(3) 2, 2, 2, 2		1.260	1.250	Dry	1.250	
28	Trk, 2½ T 4 x 2, 4110213	4-H	C	(1) 2, 2, 2, 2		1.220	1.220	1.220	1.220	
				(2) 2, 2, 2, 2		1.220	1.220	1.220	1.220	
				(3) 2, 2, 2, 2		1.230	1.210	1.200	1.240	
29	Trk, 1½ T 4 x 2, 366967	2-H	C							Withdrawn.
30	Trk, 1½ T 4 x 2, 3280410	2-H	C	(1) 2, 2, 2.1, 2.1		1.270	1.270	1.280	1.280	
				(2) 2, 2, 2.1, 2.1		1.270	1.270	1.280	1.280	
				(3) 2, 2, 2.1, 2.1		1.270	1.270	1.280	1.280	
31	Sedan (Chev.), 143169	M-1	D	(1) 2, 2, 2.1, 2		1.260	1.260	1.260	1.260	
				(2) 2, 2, 2.1, 2		1.280	1.280	1.270	1.270	
				(3) 2, 2, 2.1, 2		1.260	1.280	1.280	1.280	
32	Carryall, 4 x 2, 295319	2-H	D	(1) 2, 2, 2, 2		1.130	1.200	1.240	1.240	
				(2) 2, 2, 2, 2		1.140	1.210	1.240	1.240	
				(3) 2, 2, 2, 2		Dry	1.210	1.240	1.220	
33	Trk, ½ T, 4 x 2, 244941	M-1	D	(1) 2, 2.1, 2, 2.2		1.240	1.240	1.240	1.260	
				(2) 2, 2.1, 2, 2.2		1.240	1.240	1.240	1.260	
				(3) 2, 2.2, 2, 2.2		1.240	1.250	Dry	1.260	
34	Trk, ½ T, 4 x 2, 243268	M-1	D	(1) 2.1, 2.1, 2, 2		1.300	1.290	Dry	1.280	
				(2) 2.1, 2.1, 2, 2		1.300	1.290	Dry	1.280	
				(3) 2.2, 2.2, 2, 2		1.300	1.290	Dry	1.260	
35	Trk, ½ T, 4 x 2, 2269304	2-H	D							Do.
36	Trk, ½ T, 4 x 2, 298440	2-H	D	(1) 2, 2, 1.5, 2		1.220	1.220	1.180	1.180	
				(2) 2, 2, 2, 2		1.260	1.280	1.260	1.260	
				(3) 2.1, 2, 2, 2		1.240	1.250	1.220	1.240	

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
37	Trk, 2½ T, 4 x 2, 492653	4–H	D	(1) 2.2, 2, 2, 2		1.280	1.190	1.130	1.150			
				(2) 2.2, 2, 2, 2		1.280	1.160	1.140	1.160			
				(3) 2.2, 2, 2, 2		1.280	Dry	1.130	1.160			
38	Trk, 2½ T, 4 x 2, 4109307	4–H	D	(1) 2.2, 2.2, 2.2, 2		1.300	1.300	1.290	1.290			
				(2) 2.2, 2.2, 2.2, 2		1.300	1.300	1.290	1.290			
				(3) 2.2, 2.2, 2.2, 2		1.300	1.300	1.290	1.290			
39	Trk, 1½ T, 4 x 2, 367378	2–H	D	(1) 2, 2, 2, 2		1.260	1.260	1.260	1.260			
				(2) 2, 2, 2, 2		1.280	1.260	1.250	1.260			
				(3) 2, 2, 2, 2		1.280	1.260	1.280	1.260			
40	Trk, 1½ T, 4 x 2, 366966	2–H	D	(1) 2, 2, 2, 2		1.240	1.250	1.260	1.280			
				(2) 2.2, 2, 2, 2.1		1.280	1.270	1.290	1.290			
				(3) 2.1, 2, 2, 2		1.280	1.270	1.280	1.280			

EXPLANATORY NOTES

Battery No. B–13, withdrawn February 1949.
Report:
(a) Generator charging rate was 15 amperes at 7 volts.
(b) Gravity when battery failed was 1.100.
(c) All cells indicated a voltage reading of 1.5 volts.
(d) Sediment in 1 quart jar was ½ inch in 2 cells, and ½ inch in 1 cell
(e) Type of separators were wood.
(f) Remarks:
(1) Positive plates showed a crumbled condition and were useless for future use.
(2) No sulfation on negative plates.
(3) Negative plates were in good condition.
(4) Separators were in good condition.
(5) Battery was rebuilt at this station in 1945 and showed no evidence of repairs or rebuild at any later date.

HEADQUARTERS, MOUNT RAINIER ORDNANCE DEPOT,
Tacoma, Wash., April 4, 1949.

Subject: Report on field service test of transport vehicle batteries containing Protecto-Charge.
To: Chief of Ordnance, Department of the Army, Washington 25, D. C.
(Attention: ORDFM-Auto.)

Enclosed is subject report for month of March forwarded in compliance with your letter, subject as above, dated August 9, 1948, file: 00 412.4/877.

RAY O. WELCH,
Colonel, Ordnance Department, Commanding.

One enclosure, report (in duplicate).

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
1	Sedan (Plymouth), 141835	M-1	C	(1) 2, 2, 2, 2.1		1.260	1.260	1.280	1.280			
				(2) 2.1, 2, 2, 2.1		1.260	1.250	1.280	1.280			
				(3) 2, 2, 2, 2.1		1.260	1.260	1.270	1.280			
2	Trk, ½ T, 4 x 4, 20304108	2-H	C	(1) 2, 2, 2, 2.1		1.280	1.260	1.280	1.290			
				(2) 2, 2, 2, 2.1		1.260	1.240	1.280	1.280			
				(3) 2, 2, 2, 2.2		1.260	1.280	1.280	1.290			
3	Trk, ½ T, 4 x 2, 244359	2-H	C	(1) 2.1, 2, 2, 2		1.260	1.240	1.290	1.280			
				(2) 2.2, 2, 2, 2		1.240	1.260	1.290	1.280			
				(3) 2.1, 2, 2, 2		1.250	1.270	1.290	1.280			
4	Trk, ½ T, 4 x 2, 295785	M-1	C	(1) 2, 2, 2, 2		1.280	1.300	1.240	1.300			
				(2) 2, 2, 2, 2		1.280	1.280	1.290	1.300			
				(3) 2, 2, 2, 2		1.280	1.300	1.290	1.300			
5	Trk, ½ T, 4 x 2, 2267031	M-1	C	(1) 2, 2, 2, 2.1		1.280	1.260	1.280	1.290			
				(2) 2, 2, 2, 2.1		1.260	1.260	1.280	1.290			
				(3) 2, 2, 2, 2.1		1.270	1.260	1.280	1.290			
6	Trk, ½ T, 4 x 2, 296953	2-H	C	(1) 2.1, 2, 2, 2		1.280	1.260	1.280	1.280			
				(2) 2, 2, 2, 2		1.270	1.260	1.280	1.280			
				(3) 2.1, 2, 2, 2		1.260	1.280	1.280	1.280			
7	Trk, 2½ T, 4 x 2, 4109937	4-H	C	(1) 2, 2, 2, 2		1.300	1.300	1.290	1.290			
				(2) 2, 2, 2, 2		Dry	1.300	1.290	1.290			
				(3) 2, 2, 2, 2		1.300	1.300	1.290	1.280			
8	Trk, 2½ T, 4 x 2, 4110213	4-H	C	(1) 2, 2, 2, 2		1.240	1.250	1.240	1.220			
				(2) 2, 2, 2, 2		1.230	1.250	1.230	1.220			
				(3) 2, 2, 2, 1.9		1.230	1.250	1.230	1.210			
9	Trk, 1½ T, 4 x 2, 366967	2-H	C	(1)								Withdrawn.
10	Trk, 1½ T, 4 x 2, 3250410	2-H	C	(1) 2, 2, 2, 2		1.280	1.250	1.300	1.300			
				(2) 2, 2, 2, 2		1.270	1.250	1.300	1.290			
				(3) 2, 2, 2, 2		1.280	1.250	1.280	1.290			
11	Sedan (Chev), 142614	M-1	B									Do.
12	Trk, ¼ T, 4 x 4, 20302591	2-H	B									Do.
13	Trk, ½ T, 4 x 2, 2200298	M-1	B									Do.
14	Trk, ½ T, 4 x 2, 255172	2-H	B	(1) 2, 2, 2.1, 2		1.270	1.270	1.260	1.250			
				(2) 2, 2, 2.1, 2		1.280	1.280	1.270	1.250			
				(3) 2, 2, 2.1, 2		1.270	1.270	1.260	1.250			
15	Trk, ½ T, 4 x 2, 255126	2-H	B	(1) 2, 2, 2, 2.1		1.240	1.250	1.270	1.270			
				(2) 2, 2, 2, 2.1		1.240	1.240	1.270	1.270			
				(3) 2, 2, 2, 2.2		1.240	1.240	1.270	1.270			
16	Trk, 2½ T, 4 x 2, 4453001	4-H	B	(1) 2, 2, 2, 2		1.240	1.260	1.240	1.260			
				(2) 2, 2, 2, 2		1.240	1.260	1.260	1.270			
				(3) 2, 2, 2, 2		1.240	1.260	1.260	1.260			

17	Trk, 1½ T, 4 x 2, 367379	2-H	B	(1) 2, 2, 2, 2.2		1.240	1.260	1.290	1.290	
				(2) 2, 2, 2, 2.1		1.230	1.260	1.270	1.270	
				(3) 2, 2, 2, 2.2		1.210	1.260	1.290	1.290	
18	Trk, 1½ T, 4 x 2, 367373	2-H	B	(1) 2, 2, 2, 2		1.160	1.170	1.180	1.190	
				(2) 2, 2, 2, 2		1.200	1.190	1.210	1.220	
				(3) 2, 2, 2, 2		1.200	1.190	1.220	1.220	
19	Trk, 2½ T, 4 x 2, 571548	4-H	B	(1) 2, 2, 2, 2		1.220	1.240	1.210	1.210	
				(2) 2, 2, 2, 2		1.220	1.250	1.210	1.210	
				(3) 2, 2, 2, 2		1.220	1.240	1.210	1.200	
20	Trk, 2½ T, 4 x 2, 571548	4-H	B	(1) 2, 2, 2, 1.5		1.240	1.240	1.230	1.150	
				(2) 2, 2, 2, 1.5		1.240	1.240	1.220	1.150	
				(3) 2, 2, 2, 1.5		1.240	1.260	1.230	1.150	
21	Sedan (Chev), 143169	M-1	D	(1) 2, 2, 2, 2.2		1.240	1.280	1.290	1.300	
				(2) 2, 2, 2, 2.2		1.240	1.280	1.290	1.300	
				(3) 2, 2, 2, 2.1		1.240	1.280	1.290	1.290	
22	Carryall, 4 x 2, 295319	2-H	D	(1) 2, 2, 2, 2.1		1.240	1.260	1.260	1.260	
				(2) 2, 2, 2, 2		1.240	1.260	1.260	1.260	
				(3) 2, 2, 2, 2		1.240	1.260	1.260	1.260	
23	Trk, ½ T, 4 x 2, 244941	M-1	D	(1) 2, 2, 2, 2.2		1.240	1.280	1.280	1.280	
				(2) 2, 2, 2, 2.1		1.240	1.260	1.270	1.280	
				(3) 2, 2, 2, 2.1		1.260	1.280	1.280	1.280	
24	Trk, ½ T, 4 x 2, 243268	M-1	D	(1) 2, 2, 2, 2.1		1.260	dry	1.260	1.270	
				(2) 2, 2, 2, 2.1		1.280	dry	1.280	1.280	
				(3) 2, 2, 2, 2		1.290	dry	1.260	1.270	
25	Trk, ½ T, 4 x 2, 2269004	2-H	D							
26	Trk, ½ T, 4 x 2, 298440	2-H	D	(1) 2, 2, 2		1.180	1.180	1.170	1.180	
				(2) 2, 2, 2		1.240	1.240	1.250	1.250	
				(3) 2, 2, 2		1.230	1.220	1.250	1.260	
27	Trk, 2½ T, 4 x 2, 492653	4-H	D	(1) 2, 2, 2, 2		1.280	1.280	1.290	1.280	
				(2) 2, 2, 2, 2		1.280	1.280	1.270	1.280	
				(3) 2, 2, 2, 2		1.280	1.280	1.270	1.290	
28	Trk, 2½ T, 4 x 2, 4109307	4-H	D	(1) 2, 2, 2.1, 2.2		1.240	1.280	1.280	1.280	
				(2) 2, 2, 2.1, 2.1		Dry	1.280	1.280	1.280	
				(3) 2, 2, 2.1, 2.2		Dry	1.280	1.280	1.280	
29	Trk, 1½ T, 4 x 2, 367375	2-H	D	(1) 2, 2, 2.2, 2.1		1.260	1.300	1.300	1.300	
				(2) 2, 2, 2.2, 2.1		1.260	1.300	1.300	1.290	
				(3) 2, 2, 2.2, 2.1		1.260	1.300	1.300	1.290	
30	Trk, 1½ T, 4 x 2, 366966	2-H	D	(1) 2, 2, 2, 2		1.280	1.280	Dry	1.280	
				(2) 2, 2, 2, 2		1.290	1.300	Dry	1.290	
				(3) 2, 2, 2, 2		1.280	1.300	1.300	1.290	
31	Sedan (Plymouth), 142852									Do.
32	Trk, ¼ T, 4 x 4, 20708755	2-H	A	(1) 2, 2, 2		Charge	1.290	1.230	1.240	
				(2) 2, 2, 2		Charge	1.290	1.240	1.240	
				(3) 2, 2, 2		Charge	1.280	1.240	1.250	
33	Trk, ½ T, 4 x 2, 256630	2-H	A	(1) 2, 2, 2, 2		1.270	1.280	1.270	1.290	
				(2) 2, 2, 2, 2		1.260	1.280	1.280	1.290	
				(3) 2, 2, 2, 2		1.280	1.280	1.270	1.290	
34	Trk, ½ T, 4 x 2, 256962	2-H	A	(1) 2, 2, 2, 2		1.250	1.240	1.260	1.280	
				(2) 2, 2, 2, 2.2		1.250	1.240	1.260	1.280	
				(3) 2, 2, 2, 2.1		1.250	1.240	1.260	1.280	
35	Trk, ½ T, 4 x 2, 255064									Do.

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Type, A, B, C, D			1st week	2d week	3d week	4th week	5th week		
36	Trk, 2½ T, 4 x 2, 4453006	4–H	A	(1) 2, 2, 2, 2		1.280	1.270	1.260	1.260			
				(2) 2, 2, 2, 2		1.270	1.290	1.260	1.260			
				(3) 2, 2, 2, 2		1.260	1.270	1.260	1.260			
37	Trk, 1½ T, 4 x 2, 3146144											Withdrawn.
38	Trk, 1½ T, 4 x 2, 367419	2–H	A	(1) 1.5, 2, 2, 2.1		1.270	1.280	1.270	1.270			
				(2) 2, 2, 2, 2		1.220	1.240	1.230	1.240			
				(3) 2, 2, 2, 2		1.220	1.230	1.230	1.240			
39	Trk, 2½ T, 4 x 2, 571552	4–H	A	(1) 2, 2, 2, 2		1.240	1.250	1.260	1.250			
				(2) 2, 2, 2, 2		1.260	1.260	1.260	1.260			
				(3) 2, 2, 2, 2		1.240	1.250	1.250	1.240			
40	Trk, 2½ T, 4 x 2, 571552	4–H	A	(1) 2, 2, 2, 2		1.260	1.260	1.260	1.260			
				(2) 2, 2, 2, 2		1.260	1.260	1.260	1.260			
				(3) 2, 2, 2, 2		1.260	1.260	1.260	1.250			

MAY 13, 1949.

Subject: Report on field service test of transport vehicle batteries containing Protecto-Charge.

To: Chief of Ordnance, Department of the Army, Washington 25, D. C.
(Attention ORDFM–EM.)

In compliance with letters, your office, dated August 9, 1948, file: 00 412.4/877, and April 20, 1949, subject as above, enclosed is final report of results of action of subject test.

RAY O. WELCH,
Colonel, Ordnance Department,
Commanding.

One enclosure: Report (in duplicate).

Line No.	Vehicle nomenclature and United States registration No.	Charging rate—maximum voltage and rate	Specific gravity	Breakdown rate	Sediment in jar	Type of separators	Remarks
					Inch		
1	Sedan (Plymouth) 141836 M1 & C1.	15 amperes at 6.8 volts.	(1) 1.270	1.6	1/8	Wood	
			(2) 1.290	1.6	1/8		
			(3) 1.270	1.6	1/8		
2	Trk, 1½ T 4 x 4 20304108 2 H & C2.	35 amperes at 7 volts.	(1) 1.250	1.5	1/4	do	
			(2) 1.250	1.6	1/4		
			(3) 1.250	1.5	1/4		
3	Trk, ½ T 4 x 2 244359 2H & C3.	15 amperes at 7 volts.	(1) 1.250	1.6	3/8	do	
			(2) 1.250	1.6	3/8		
			(3) 1.270	1.6	1/4		
4	Trk, ½ T 4 x 2 295785 M1 & C4.	15 amperes at 6.5 volts.	(1) 1.250	1.6	1/4	do	
			(2) 1.290	1.5	1/4		
			(3) 1.290	1.6	1/4		
5	Trk, ½ T 4 x 2 2267031 M1 & C5.	10 amperes at 6.7 volts.	(1) 1.290	1.6	1/8	do	
			(2) 1.290	1.6	1/8		
			(3) 1.290	1.6	1/8		
6	Trk, ½ T 4 x 2 296953 2H & C6.	15 amperes at 6.5 volts.	(1) 1.270	1.5	1/4	do	
			(2) 1.270	1.5	1/4		
			(3) 1.270	1.5	1/4		
7	Trk, 2½ T 4 x 2 4109937 4H & C7.	35 amperes at 7.5 volts.	(1) NR	1.6	1/8	Rubber	
			(2) NR	1.6	1/8		
			(3) NR	1.6	1/8		
8	Trk, 2½ T 4 x 2 4110213 4H & C8.	30 amperes at 7 volts.	(1) 1.270	1.6	1/8	do	
			(2) 1.270	1.6	1/8		
			(3) 1.270	1.6	1/8		
9	Trk, 1½ T 4 x 2 306967 2H & C9.	15 amperes at 6.9 volts.					Withdrawn.
10	Trk, 1½ T 4 x 2 3280410 2H & C10.	10 amperes at 6.5 volts.	(1) 1.270	1.5	1/8	Wood	
			(2) 1.290	1.5	1/8		
			(3) 1.290	1.5	1/8		
11	Sedan (Chev.) 142614 M1 & B1.						Do.
12	Trk, ½ T 4 x 4 20302591 2H & B2.						Do.
13	Trk, ½ T 4 x 2 2200298 2H & B3.						Do.
14	Trk, ½ T 4 x 2 255172 2H & B4.	15 amperes at 6.5 volts.	(1) NR	1.6	1/2	Rubber	Positive plates broken.
			(2) NR	(1)	1/2		
			(3) NR	1.5	1/2		
15	Trk, ½ T 4 x 2 255126 2H & B5.	12 amperes at 6.5 volts.	(1) 1.250	1.6	1/4	do	
			(2) 1.250	1.6	1/4		
			(3) 1.250	1.6	1/4		
16	Trk, 2½ T 4 x 2 4453001	35 amperes at 7 volts.	(1) 1.250	1.6	5/8	Wood	
			(2) 1.250	1.6	5/8		
			(3) 1.250	1.6	5/8		
17	Trk, 1½ T 4 x 2 367379 2H & B7.	15 amperes at 7 volts.	(1) 1.270	1.5	5/8	Rubber	
			(2) 1.270	1.6	5/8		
			(3) 1.270	1.5	5/8		
18	Trk, 1½ T 4 x 2 367373 2H & B8.	10 amperes at 6.5 volts.	(1) 1.190	1.5	1/4	do	
			(2) 1.190	1.5	1/4		
			(3) 1.190	1.5	1/4		
19	Trk, 2½ T 4 x 2 571548	40 amperes at 12.8 volts.	(1) 1.250	1.6	1/2	do	
			(2) 1.250	1.6	1/2		
			(3) 1.250	1.6	1/2		
20	Trk, 2½ T, 4 x 2, 571548 4H & B10.	do	(1) 1.250	1.8	1/8	do	
			(2) 1.250	1.6	1/8		
			(3) 1.250	1.6	1/8		

[1] Dead.

Line No.	Vehicle nomenclature and United States registration No.	Charging rate—maximum voltage and rate	Specific gravity	Breakdown rate	Sediment in jar	Type of separators	Remarks
					Inch		
21	Sedan (Chev.), 143169 M1 & D1.	25 amperes at 6.5 volts.	(1) 1.150 (2) 1.150 (3) 1.150	1.4 1.5 1.4	1/8 1/8 1/8	Wood	
22	Carryall, 4 x 2, 295319 2H & D2.	15 amperes at 6.5 volts.	(1) 0 (2) 0 (3) 0	(1) (1) (1)	1/4	Wood; spongy plates.	No rebuild.
23	Trk, ¾ T, 4 x 2, 244041 M1 & D3.						
24	Trk, ½ T, 4 x 2, 243268 M1 & D4.	15 amperes at 7 volts.	(1) 1.310 (2) 1.290 (3) 1.277	1.5 1.5 1.5	1/4 1/4 1/4	Wood	
25	Trk, ½ T, 4 x 2, 2269304 2H & D5.						Withdrawn.
26	Trk, ½ T, 4 x 2, 208440 2H & D6.	12 amperes at 6.5 volts.	(1) 1.250 (2) 1.250 (3) 1.210	1.5 1.5 1.5	1/4 1/4 1/4	Wood	
27	Trk, 2½ T, 4 x 2, 492653 4H & D7.	35 amperes at 8 volts.	(1) 1.210 (2) 1.210 (3) 1.210	1.6 1.6 1.6	3/16 3/16 3/16	Rubber	
28	Trk, 2½ T, 4 x 2, 4109307 4H & D8.	35 amperes at 7.5 volts.	(1) 1.290 (2) 1.290 (3) 1.290	1.6 1.6 1.6	1/4 1/4 1/4	Rubber	
29	Trk, 1¼ T, 4 x 2, 367378 2H & D9.	15 amperes at 6.5 volts.	(1) 1.290 (2) 1.290 (3) 1.290	1.6 1.6 1.6	1/2 1/2 1/2	Wood	
30	Trk, 1½ T, 4 x 2, 366966 2H & D10.	15 amperes at 6.9 volts.	(1) NR (2) NR (3) NR	1.6 1.6 1.6	1/4 1/4 1/4	do	No water.
31	Sedan (Plymouth), 142852 A1.						Withdrawn.
32	Trk, ¼ T, 4 x 4, 20706755 2H & A2.	35 amperes at 7 volts.	(1) 1.270 (2) 1.270 (3) 1.270	1.4 1.5 1.6	1/4 1/4 1/4	Rubber	
33	Trk, ⅛ T, 4 x 2, 256630 2H & A3.	15 amperes at 6.5 volts.	(1) 1.270 (2) 1.270 (3) 1.270	1.5 1.5 1.5	3/16 3/16 3/16	Wood	
34	Trk, ⅛ T, 4 x 2, 256962 2H & A4.	12 amperes at 6.5 volts.	(1) 1.290 (2) 1.290 (3) 1.290	1.5 1.5 1.5	1/4 1/4 1/4	Rubber	
35	Trk, ⅛ T, 4 x 2, 255064 A5.						Do.
36	Trk, 2½ T, 4 x 2, 4453006 4H & A6.	30 amperes at 7 volts.	(1) RN (3) RN (3) RN	1.6 1.6 1.6	1/4 1/4 1/4	Wood	
37	Trk, 1½ T, 4 x 2, 3146144 2H & A7.						Do.
38	Trk, ⅞ T, 4 x 2, 367419 2H & A8.	15 amperes at 6.5 volts.	(1) 1.250 (2) 1.250 (3) 1.250	1.5 1.4 1.4	1/4 1/4 1/4	Rubber	
39	Trk, 2½ T, 4 x 2, 571552 4H & A9.	25 amperes at 12.5 volts.	(1) 1.230 (2) 1.250 (3) 1.230	1.5 1.5 1.5	1/2 1/2 1/2	Wood	
40	Trk, 2½ T, 4 x 2, 571552	do	(1) 1.210 (2) 1.230 (3) NR	1.6 1.5 1.5	1/8 1/8 1/8	Rubber	

[1] No voltage shown.

Letter reports of field service test of Protecto-Charge (AD–X2) from Red River Arsenal, Texarkana, Tex.

2. This is final report concluding test at this installation—May 28, 1949.

Number	Vehicle and registration number	Battery type		Voltage reading from test	Specific gravity	Date	Remarks
		Standard nomenclature	Type A, B, C, D				
2	Truck, ¼ T., 20703609	2–H	A	(1) 2.2, 2.0, 2.0, 2.0 (2) 2.2, 2.0, 2.0, 2.0 (3) 2.2, 2.0, 2.0, 2.0	1.160, 1,170, 1.180, 1.200 1.210, 1.220, 1.210, 1.220 1.210, 1.220, 1.210, 1.220	May 26, 1949	See explanatory note No. 2.
4	Truck, ¼ T., 20690161	2–H	A	(1) 2.2, 2.2, 2.2, 2.0 (2) 2.2, 2.2, 2.2, 2.0 (3) 2.2, 2.2, 2.2, 1.8	1.230, 1.250, 1.240, 1.220 1.190, 1.210, 1.240, 1.150 1.230, 1.200, 1.240, 1.150	May 23, 1949	See explanatory note No. 4.
5	Truck, GMC, 2½ T., 6 x 6 4917203	4–H	A	(1) 2.2, 2.2, 2.0, 2.0 (2) 2.2, 2.2, 2.0, 2.0 (3) 2.2, 2.2, 2.0, 2.0	1.180, 1.180, 1.150, 1.170 1.180, 1.180, 1.150, 1.160 1.170, 1.180, 1.150, 1.150	May 26, 1949	See explanatory note No. 5.
6	Truck, GMC, 2½ T., 6 x 6 4835831	4–H	A	(1) 2.1, 2.0, 2.2, 2.0 (2) 2.1, 2.0, 2.2, 2.0 (3) 2.1, 2.0, 2.2, 2.0	1.190, 1.220, 1.225, 1.170 1.210, 1.225, 1.225, 1.220 1.210, 1.220, 1.225, 1.210	May 24, 1949	See explanatory note No. 6.
8	Truck, GMC, 2½ T., 6 x 6 4817522	4–H	A	(1) 2.2, 2.2, 2.2, 2.1 (2) 2.2, 2.2, 2.2, 2.1 (3) 2.2, 2.2, 2.2, 2.1	1.210, 1.210, 1.220, 1.230 1.220, 1.220, 1.230, 1.220 1.230, 1.230, 1.240, 1.245	May 26, 1949	See explanatory note No. 8.
10	Truck, GMC, 2½ T., 6 x 6 4338546	4–H	A	(1) 2.0, 2.2, 2.1, 2.0 (2) 2.0, 2.2, 2.1, 2.0 (3) 2.0, 2.2, 2.1, 2.0	1.160, 1.180, 1.180, 1.190 1.160, 1.190, 1.180, 1.190 1.160, 1.190, 1.180, 1.190	May 26, 1949	See explanatory note No. 10.
11	Truck, GMC, 2½ T., 6 x 6 4917207	4–H	B	(1) 2.2, 2.2, 2.2, 2.1 (2) 2.2, 2.2, 2.2, 2.1 (3) 2.2, 2.2, 2.2, 2.1	1.220, 1.220, 1.220, 1.210 1.220, 1.220, 1.220, 1.210 1.225, 1.230, 1.220, 1.210	May 25, 1949	See explanatory note No. 11.
12	Truck, GMC, 2½ T., 6 x 6 43338	4–H	B	(1) 2.1, 2.2, 2.2, 2.1 (2) 2.1, 2.2, 2.2, 2.1 (3) 2.1, 2.2, 2.2, 2.1	1.250, 1.250, 1.260, 1.250 1.240, 1.240, 1.250, 1.250 1.250, 1.250, 1.260, 1.270	May 25, 1949	See explanatory note No. 12.
13	Truck, GMC, 2½ T., 6 x 6 4912314	4–H	B	(1) 2.2, 2.2, 2.2, 2.0 (2) 2.2, 2.2, 2.2, 2.0 (3) 2.2, 2.2, 2.2, 2.0	1.240, 1.220, 1.240, 1.220 1.240, 1.220, 1.240, 1.230 1.240, 1.230, 1.240, 1.230	May 23, 1949	See explanatory note No. 13.
14	Truck, GMC, 2½ T., 6 x 6 4917024	4–H	B	(1) 2.2, 2.2, 2.1, 2.0 (2) 2.2, 2.2, 2.1, 2.0 (3) 2.2, 2.2, 2.1, 2.0	1.200, 1.250, 1.230, 1.220 1.210, 1.240, 1.240, 1.230 1.210, 1.250, 1.230, 1.230	May 25, 1949	See explanatory note No. 14.
17	Truck, GMC, 2½ T 6x 6 60106739	4–H	B	(1) 2.2, 2.2, 2.0, 2.0 (2) 2.2, 2.2, 2.0, 2.0 (3) 2.2, 2.2, 2.0, 2.0	.230, 1.240, 1.230, 1.190 1.230, 1.240, 1.230, 1.190 1.230, 1.240, 1.240, 1.190	May 26, 1949	See explanatory note No. 17.
18	Truck, GMC, 2½ T 6 x 6 4917295	4–H	B	(1) 2.2, 2.1, 2.0, 2.1 (2) 2.2, 2.1, 2.0, 2.1 (3) 2.2, 2.1, 2.1, 2.1	1.200, 1.190, 1.230, 1.250 1.200, 1.195, 1.230, 1.250 1.190, 1.195, 1.210, 1.240	May 26, 1949	See explanatory note No. 18.

Letter reports of field service test of Protecto-Charge (AD X2) from Red River Arsenal, Texarkana, Tex.—Continued

Number	Vehicle and registration number	Battery type		Voltage reading from test	Specific gravity	Date	Remarks
		Standard nomenclature	Type A, B, C, D				
20	Truck, GMC, 2½ T 6 x 6 4917077	4-H	B	(1) 2.2, 2.2, 2.2, 2.0 (2) 2.2, 2.2, 2.2, 2.0 (3) 2.2, 2.2, 2.2, 2.0	1.270, 1.270, 1.280, 1.190 1.270, 1.270, 1.280, 1.190 1.270, 1.270, 1.280, 1.190	May 26, 1949	See explanatory note No. 20.
21	Truck, GMC, 2½ T 6 x 6 4917077	4-H	C	(1) 2.2, 2.2, 2.0, 2.0 (2) 2.2, 2.2, 2.0, 2.0 (3) 2.2, 2.2, 2.0, 2.0	1.240, 1.220, 1.240, 1.220 1.220, 1.220, 1.240, 1.220 1.250, 1.220, 1.250, 1.230	May 27, 1949	See explanatory note No. 21.
23	Truck, GMC, 2½ T 6 x 6 4916551	4-H	C	(1) 2.2, 2.2, 2.2, 2.0 (2) 2.2, 2.2, 2.2, 2.0 (3) 2.2, 2.2, 2.2, 2.0	1.230, 1.250, 1.240, 1.250 1.225, 1.200, 1.240, 1.240 1.230, 1.240, 1.240, 1.230	May 23, 1949	See explanatory note No. 23.
24	Truck, GMC, 2½ T 6 x 6 4922078	4-H	C	(1) 2.2, 2.2, 2.0, 2.0 (2) 2.2, 2.2, 2.0, 2.0 (3) 2.2, 2.2, 2.0, 2.0	1.190, 1.210, 1.200, 1.210 1.190, 1.210, 1.200, 1.210 1.190, 1.210, 1.200, 1.210	May 27, 1949	See explanatory note No. 24.
25	Truck, GMC, 2½ T 6 x 6 4835477	4-H	C	(1) 2.1, 2.2, 2.1, 2.0 (2) 2.1, 2.2, 2.1, 2.0 (3) 2.1, 2.2, 2.1, 2.0	1.500, 1.220, 1.190, 1.210 1.200, 1.220, 1.190, 1.210 1.200, 1.220, 1.190, 1.210	May 25, 1949	See explanatory note No. 25.
26	Truck, GMC, 2½ T 6 x 6 4912140	4-H	C	(1) 2.0, 2.2, 2.2, 2.0 (2) 2.0, 2.2, 2.2, 2.0 (3) 2.0, 2.2, 2.2, 2.0	1.190, 1.270, 1.230, 1.270 1.190, 1.270, 1.230, 1.260 1.190, 1.270, 1.230, 1.290	May 24, 1949	Charged May 3, 1949. See explanatory note No. 26.
27	Truck, GMC, 2½ T 6 x 6 4919221	4-H	C	(1) 2.2, 2.2, 2.1, 2.0 (2) 2.2, 2.2, 2.1, 2.0 (3) 2.2, 2.2, 2.1, 2.0	1.250, 1.260, 1.235, 1.210 1.250, 1.260, 1.235, 1.210 1.250, 1.260, 1.235, 1.210	May 27, 1949	See explanatory note No. 27.
28	Truck, GMC, 2½ T 6 x 6 4476327	4-H	C	(1) 2.2, 2.2, 2.0, 2.0 (2) 2.2, 2.2, 2.0, 2.0 (3) 2.2, 2.2, 2.0, 2.0	1.260, 1.220, 1.210, 1.220 1.250, 1.270, 1.210, 1.220 1.270, 1.220, 1.240, 1.240	May 27, 1949	See explanatory note No. 28.
29	Truck, GMC, 2½ T 6 x 6 4917241	4-H	C	(1) 2.0, 2.1, 2.2, 2.0 (2) 2.0, 2.1, 2.2, 2.0 (3) 2.0, 2.1, 2.2, 2.0	1.210, 1.200, 1.200, 1.170 1.210, 1.200, 1.200, 1.170 1.190, 1.200, 1.200, 1.190	May 23, 1949	See explanatory note No. 29.
30	Truck, GMC, 2½ T 6 x 6 4923358	4-H	C	(1) 2.1, 2.2, 2.2, 2.0 (2) 2.1, 2.2, 2.2, 2.0 (3) 2.1, 2.2, 2.2, 2.0	1.240, 1.250, 1.270, 1.250 1.270, 1.260, 1.260, 1.240 1.250, 1.255, 1.270, 1.260	May 23, 1949	See explanatory note No. 30.
31	Truck, GMC, 2½ T 6 x 6 4916597	4-H	D	(1) 2.2, 2.1, 2.0, 2.1 (2) 2.2, 2.1, 2.0, 2.1 (3) 2.2, 2.1, 2.0, 2.1	1.170, 1.190, 1.200, 1.190 1.190, 1.200, 1.200, 1.190 1.180, 1.200, 1.200, 1.190		See explanatory note No. 31.
32	Truck, GMC, 2½ T 6 x 6 4916298	4-H	D	(1) 2.1, 2.2, 2.2, 2.1 (2) 2.1, 2.2, 2.2, 2.1 (3) 2.1, 2.2, 2.2, 2.1	1.210, 1.250, 1.230, 1.230 1.200, 1.240, 1.210, 1.200 1.190, 1.240, 1.210, 1.200		See explanatory note No. 32.
33	Truck, GMC, 2½ T., 6 x 6 801686	4-H	D	(1) 2.1, 2.0, 2.2, 2.0 (2) 2.1, 2.0, 2.2, 2.0 (3) 2.1, 2.0, 2.2, 2.0	1.190, 1.180, 1.230, 1.240 1.190, 1.170, 1.230, 1.240 1.190, 1.170, 1.230, 1.240		Charged May 11, 1949. See explanatory note No. 33.

34	Truck, GMC, 2½ T., 6 x 6 4864735	4-H	D	(1) 2.1, 2.2, 2.2, 2.0	1.190, 1.210, 1.210, 1.210	See explanatory note No. 34.
				(2) 2.1, 2.2, 2.2, 2.0	1.190, 1.210, 1.210, 1.210	
				(3) 2.1, 2.2, 2.2, 2.0	1.190, 1.210, 1.210, 1.210	
35	Truck, GMC, 2½ T., 6 x 6 4916592	4-H	D	(1) 2.0, 2.2, 2.2, 2.0	1.150, 1.240, 1.250, 1.230	Charged May 2, 1949.
				(2) 2.0, 2.2, 2.2, 2.0	1.150, 1.240, 1.250, 1.200	See explanatory Note No. 35.
				(3) 2.0, 2.2, 2.2, 2.0	1.150, 1.240, 1.250, 1.200	
36	Truck, GMC, 2½ T., 6 x 6 4476169	4-H	D	(1) 2.1, 2.2, 2.2, 2.0	1.230, 1.280, 1.300, 1.280	See explanatory note No. 36.
				(2) 2.1, 2.2, 2.2, 1.3	1.235, 1.310, 1.300, 1.150	
				(3) 2.1, 2.2, 2.2, 2.0	1.225, 1.310, 1.300, 1.290	
37	Truck, GMC, 2½ T., 6 x 6 4917208	4-H	D	(1) 2.0, 2.2, 2.2, 2.0	1.175, 1.210, 1.170, 1.180	See explanatory note No. 37
				(2) 2.0, 2.2, 2.2, 2.0	1.185, 1.210, 1.170, 1.160	
				(3) 2.0, 2.2, 2.2, 2.0	1.195, 1.210, 1.170, 1.170	
38	Truck, GMC, 2½ T., 6 x 6 8013598	4-H	D	(1) 2.0, 2.1, 2.2, 2.0	1.160, 1.190, 1.150, 1.170	See explanatory note No. 38.
				(2) 2.0, 2.1, 2.2, 2.0	1.190, 1.190, 1.190, 1.210	
				(3) 2.0, 2.1, 2.2, 2.0	1.170, 1.190, 1.175, 1.180	
39	Truck, GMC, 2½ T., 6 x 6 4917274	4-H	D	(1) 2.1, 2.2, 2.2, 2.0	1.180, 1.170, 1.170, 1.150	See explanatory note No. 39.
				(2) 2.1, 2.2, 2.2, 2.0	1.180, 1.170, 1.170, 1.150	
				(3) 2.1, 2.2, 2.2, 2.0	1.180, 1.170, 1.170, 1.150	
40	Truck, GMC, 2½ T., 6 x 6 4875643	4-H	D	(1) 2.1, 2.2, 2.2, 2.1	1.250, 1.260, 1.250, 1.250	See explanatory note No. 40.
				(2) 2.1, 2.2, 2.2, 2.1	1.250, 1.260, 1.250, 1.250	
				(3) 2.1, 2.2, 2.2, 2.1	1.250, 1.260, 1.250, 1.250	

EXPLANATORY NOTES

No 2. Glass separators: Sediment in cell No. 1, 3/8 inch; sediment in cell No. 2, 3/8 inch; sediment in cell No. 3, 1/4 inch.
(a) Positive plates, dark color, broken.
(b) Negative plates, fair color, blistered, safe. Plates slightly buckled.

No. 4. Wood separators: Sediment in cell No. 1, 1 1/16 inch; sediment in cell No. 2, 1 inch; sediment in cell No. 3, 1 1/16 inches.
(a) Positive plates, gone completely, only parts of grids left.
(b) Negative plates, rotten, all active material gone. Separators completely decomposed.

No. 5. Wood separators: Sediment in cell No. 1, 1/2 inch; sediment in cell No. 2, 2 1/2 inches; sediment in cell No. 3, 1/2 inch.
(a) Positive plates, very dark and shedding, chipping. Grid broken.
(b) Negative plates, good color, safe. Separators decomposed.

No. 6. Wood separators: Sediment in cell No. 1, 3/4 inch; sediment in cell No. 2, 9/16 inch; sediment in cell No. 3, 3/4 inch.
(a) Positive plates, decomposed.
(b) Negative plates, good color, blistered on outside plates, separators decomposed.

No. 8. Spun glass separators: Sediment in cell No. 1, 1/4 inch; sediment in cell No. 2, 3/8 inch; sediment in cell No. 3, 3/8 inch.
(a) Positive plates, safe, chipping, active material, good brown color.
(b) Negative plates, brownish color, blistered.

No. 10. Wood separators: Sediment in cell No. 1, 9/16 inch; sediment in cell No. 2, 9/16 inch; sediment in cell No. 3, 9/16 inch.
(a) Positive plates, decomposed.
(b) Negative plates, decomposed, separators decomposed.

No. 11. Wood separators: Sediment in cell No. 1, 3/8 inch; sediment in cell No. 2, 1/2 inch; sediment in cell No. 3, 1/2 inch.
(a) Positive plates, completely decomposed.
(b) Negative plates, brownish color, decomposed, separators completely decomposed.

No. 12. Wood separators: Sediment in cell No. 1, 9/16 inch; sediment in cell No. 2, 5/8 inch; sediment in cell No. 3, 1/2 inch.
(a) Positive plates, rotten, safe, falling apart.
(b) Negative plates, dark gray color, decomposed, separators decomposed.

No. 13. Wood separators: Sediment in cell No. 1, 3/8 inch; sediment in cell No. 2, 5/16 inch; sediment in cell No. 3, 1/4 inch.
(a) Positive plates, decomposed, grids broken.
(b) Negative plates, decomposed, very dark gray color. Separators completely decomposed.

No. 14. Wood separators: Sediment in cell No. 1, 3/8 inch; sediment in cell No. 2, 3/8 inch; sediment in cell No. 3, 3/8 inch.
(a) Positive plates, completely decomposed.
(b) Negative plates, chipping, blistered, shedding bad, brownish color.

No. 17. Wood separators: Sediment in cell No. 1, 3/8 inch; sediment in cell No. 2, 3/8 inch; sediment in cell No. 3, 3/8 inch.
(a) Positive plates, all active material completely gone, grids broken and falling apart.
(b) Negative plates, brownish color, blistered, separators completely decomposed.

No. 18. Wood separators: Sediment in cell No. 1, 5/16 inch; sediment in cell No. 2, 5/16 inch; sediment in cell No. 3, 3/8 inch.
(a) Positive plates, broken, safe, all active material gone.
(b) Negative plates, dark, blistered and shedding. Separators decomposed.

No. 20. Wood separators: Sediment in cell No. 1, 9/16 inch; sediment in cell No. 2, 9/16 inch; sediment in cell No. 3, 9/16 inch.
(a) Positive plates, safe, falling apart, dark color, active material gone.
(b) Negative plates, brownish color, blistered, shedding, separators decomposed.

No. 21. Rubber separators: Sediment in cell No. 1, ¼ inch; sediment in cell No. 2, ¼ inch; sediment in cell No. 3, ¼ inch.
(a) Positive plates, safe, active material shedding, plate strap broken in cell No. 1.
(b) Negative plates brownish color, excessive shedding.
(c) All 3 cells badly buckled.

No. 23. Rubber separators: Sediment in cell No. 1, 1/8 inch; sediment in cell No. 2, 1/8 inch; sediment in cell No. 3, 1/8 inch.
(a) Positive plates, safe, excessive shedding.
(b) Negative plates, dull color, otherwise normal.

No. 24. Rubber separators: Sediment in cell No. 1, 1/8 inch; sediment in cell No. 2, 1/8 inch; sediment in cell No. 3, 3/16 inch.
(a) Positive plates, dark color, safe.
(b) Negative plates, brownish color.
(c) Plates badly buckled.

No. 25. Rubber separators: Sediment in cell No. 1, 3/16 inch; sediment in cell No. 2, 7/16 inch; sediment in cell No. 3, 9/16 inch.
(a) Positive plates, safe, very dark, shedding active material.
(b) Negative plates, brownish color, excessive shedding.

No. 26. Rubber separators: Sediment in cell No. 1, 1/8 inch; sediment in cell No. 2, 1/16 inch; sediment in cell No. 3, 1/8 inch.
(a) Positive plates, safe, excessive shedding of active material.
(b) Negative plates, blistered, brownish color.

No. 27. Rubber separators: Sediment in cell No. 1, ¼ inch; sediment in cell No. 2, 5/1 inch; sediment in cell No. 3, 5/16 inch.
(a) Positive plates, safe, excessive shedding, very dark.
(b) Negative plates, brownish color.
(c) Plates badly buckled.

No. 28. Rubber separators: Sediment in cell No. 1, 5/8 inch; sediment in cell No. 2, 1/2 inch; sediment in cell No. 3, 1/2 inch.
(a) Positive plates, safe, very dark in color, badly buckled.
(b) Negative plates, brownish color, blistered, badly buckled. Plates buckled.

No. 29. Rubber separators, A cell: Sediment in cell No. 1, 1/4 inch; sediment in cell No. 2, 1/8 inch; sediment in cell No. 3, 1/8 inch.
(a) Negative plates, dull color.
(b) Positive plates, safe.

No. 30. Rubber separators, A cell: Sediment in cell No. 1, 1/16 inch; sediment in cell No. 2, 3/16 inch; sediment in cell No. 3, 1/16 inch.
(a) Negative plates, brown color.
(b) Positive plates, soft.

No. 31. Rubber separators: Sediment in cell No. 1, 1/16 inch; sediment in cell No. 2, 1/16 inch; sediment in cell No. 3, 3/16 inch.
(a) Positive plates, safe, normal in color, slightly buckled.
(b) Negative plates, color, very light gray, plates slightly buckled.

No. 32. Rubber separators: Sediment in cell No. 1, 3/16 inch; sediment in cell No. 2, 3/16 inch; sediment in cell No. 3, 3/16 inch.
(a) Positive plates, normal, shedding small amount of active material.
(b) Negative plates, blistered, very light tannish gray.

No. 33. A cell, rubber separators: Sediment in cell No. 1, 1/16 inch; sediment in cell No. 2, 1/16 inch; sediment in cell No. 3, 1/16 inch.
(a) Negative plates, normal, bright color.
(b) Positive plates, normal.

No. 34. Rubber separators: Sediment in cell No. 1, 3/16 inch; sediment in cell No. 2, 1/8 inch; sediment in cell No. 3, 1/4 inch.
(a) Positive plates, normal.
(b) Negative plates, normal.

No. 35. Rubber separators: Sediment in cell No. 1, 1/8 inch; sediment in cell No. 2, 1/8 inch; sediment in cell No. 3, 1/8 inch.
(a) Positive plates, normal.
(b) Negative plates, normal. No. 2 cell slightly buckled.

No. 36. Rubber separators: Sediment in cell No. 1, ¾ inch; sediment in cell No. 2, 9/16 inch; sediment in cell No. 3, 1 inch.
(a) Positive plates, normal to safe, shedding active material, badly buckled.
(b) Negative, color very light gray to grayish tan. Plates are badly buckled.

No. 37. Rubber separators: Sediment in cell No. 1, ¼ inch; sediment in cell No. 2, 3/16 inch; sediment in cell No. 3, ¼ inch.
(a) Positive plates, normal.
(b) Negative plates, blistered, tannish, gray color.

No. 38. Rubber separators: Sediment in cell No. 1, 1/8 inch; sediment in cell No. 2, 1/8 inch; sediment in cell No. 3, 1/8 inch.
(a) Positive plates, slightly buckled.
(b) Negative plates, normal, plates slightly buckled.

No. 39. Rubber separators: Sediment in cell No. 1, ¼ inch; sediment in cell No. 2, ¼ inch; sediment in cell No. 3, 1/8 inch.
(a) Positive plates, normal.
(b) Negative plates, normal.

No. 40. Rubber separators: Sediment in cell No. 1, 3/16 inch; sediment in cell No. 2, 3/16 inch; sediment in cell No. 3, 5/16 inch.
(a) Positive plates, normal.
(b) Negative plates, tannish gray color.

RESULTS COMPILED FROM FIVE ORDNANCE BASE DEPOTS' LETTER REPORTS ON FIELD SERVICE TEST OF PROTECTO-CHARGE (AD–X2)

SEPTEMBER 26, 1949.

To: Chief of Field Service Division.
From: Chief, Maintenance Branch, Field Service Division.
Subject: Field Test of Battery Additive AD–X2 Formerly Known as Protecto-Charge.

1. In accordance with directive from Chief of Ordnance a field test of automotive storage batteries treated with battery additive AD–X2 (formerly known as Protecto-Charge), a product of Pioneers, Inc., was conducted concurrently at 5 base depots during a period of approximately 6 months.

2. The battery additive AD–X2 is a white, granular, chemical compound which, it is claimed, when added to the battery electrolyte, restores to active service approximately 70 percent of discarded sulfated batteries, and reduces harmful effects of sulfation. It is further claimed that use of the product will lengthen life expectancy of new batteries and will extend the life of mechanically sound old batteries, usually discarded because of sulfation.

3. In the subject test no attempt was made to test treated batteries under laboratory conditions. Only actual field use of the product was undertaken at the following five base dpeots located in widely separated sections of the continental United States.

a. Atlanta General Distribution Depot, Atlanta, Ga.
b. Benicia Arsenal, Benicia, Calif.
c. Letterkenny Ordnance Depot, Chambersburg, Pa.
d. Mount Rainier Ordnance Depot, Tacoma Wash.
e. Red River Arsenal, Texarkana, Tex.

4. Each of the five depots was directed to select 40 batteries to be equally divided into 4 groups of 10 batteries each. Thus a total of 200 batteries was subjected to the test. The four groups were composed of batteries in the following conditions:

a. Group A: Mechanically sound but ready for salvage batteries.
b. Group B: Batteries in use on administrative vehicles in everyday operation. The age of these batteries was immaterial provided they were not new.
c. Group C: New batteries never prepared for service. The expiration date to be approximately similar for each battery insofar as practicable.
d. Group D: New batteries never prepared for service. The expiration date to be approximately similar for each battery and to the batteries in group C.

5. Batteries in groups A, B, and C were then properly serviced and tested for good mechanical condition. If any battery developed a mechanical defect or deficiency it was discarded and replaced by one that was sound. Batteries in these three groups were then treated with AD–X2 in strict accordance with the manufacturer's instructions. The batteries were fully charged and the electrolyte adjusted to a common value.

6. Group D batteries were similarly serviced and tested but were not treated with AD–X2. Thus there were 2 groups of new batteries, 1 treated and the other untreated, in each installation for a comparative test. All test batteries were of 3 cells and 6-volt rating. Types were as follows:

Type:	Quantity
1–H	14
2–H	3
3–H	101
4–H	82
Total	200

7. All test batteries at each depot, after preparation as noted above, were then installed in administrative vehicles in current use in the immediate locality of the installation. No special runs or extremes of conditions were desired or authorized other than those normally encountered by the average vehicle during its course of daily operation. Weekly inspections were made of the batteries in the vehicles and specific gravity and voltage readings of each cell were taken and recorded. A monthly report indicating all the desired information for each battery was then forwarded to this office. The test continued for approximately 6 months. See enclosure 1, letter to installations initiating field test, and enclosure 2, form of monthly report.

8. Monthly reports received from the five test installations were tabulated and charted. The variations of the specific gravity and voltages of each cell on all batteries were noted and the successive values were properly recorded on a graph representing each of the batteries under test.

9. The results compiled from the monthly reports are as follows:

a. Group A: Salvage batteries treated with AD–X2.

(1) Total number of group A batteries at start of test, all installations, amounted to 50 or 150 cells. At the end of the first month 8 percent of the A batteries had failed, 26 failed during the second month, 9 percent the third month, 6 percent the fourth month, 4 percent the fifth month, and none the sixth and final month. A total of 33, or 46 percent, of the batteries in this group had failed at end of test. Refer to enclosure 3.

(2) As previously indicated, variations in specific gravity of each cell were recorded weekly. The variations in specific gravity in the group A batteries for each month and in percentage of cells are tabulated as follows:

(*a*) TABLE I.—*Percentage of cells with higher specific gravity per month (group A batteries)*

Month:	Percentage cells
1st	33. 2
2d	35. 6
3d	41. 2
4th	35. 2
5th	27. 0
6th	30. 5
Average entire test (see enclosure 4) approximately	34.

(*b*) TABLE II.—*Percentage of cells with lower specific gravity per month (group A batteries)*

Month:	Percentage cells
1st	47. 8
2d	38. 6
3d	36. 4
4th	36. 6
5th	45. 6
6th	48. 5
Average entire test (see enclosure 4) approximately	42.

(*c*) TABLE III.—*Percentage of cells with approximately constant specific gravity per month (group A batteries)*

Month:	Percentage cells
1st	19. 0
2d	23. 8
3d	22. 4
4th	28. 2
5th	27. 4
6th	21. 0
Average entire test (see enclosure 4) approximately	24.

b. Group B: In-use batteries treated with AD–X2.

(1) Total number of batteries in group B, all installations, at start of test was 50 or 150 cells. At end of first month 4 percent had failed, 10 percent failed the second month, 7 percent the third, none the fourth and fifth months and 5 percent failed during the sixth month. Total failures for this group were 13, or 26 percent, of the original batteries. See enclosure 3.

(2) Tables of variations in specific gravity of each cell in group B batteries are as follows:

(*a*) TABLE IV.—*Percentage of cells with higher specific gravity per month (group B batteries)*

Month:	Percentage cells
1st	30. 0
2d	31. 2
3d	46. 8
4th	33. 6
5th	34. 0
6th	19. 0
Average entire test (see enclosure 4) approximately	32.

(*b*) TABLE V.—*Percentage of cells with lower specific gravity per month) group B batteries)*

Month:	Percentage cells	Month:	Percentage cells
1st	41. 8	6th	64. 5
2d	50. 4	Average entire test (see enclosure 4) approximately	45.
3d	31. 6		
4th	36. 6		
5th	46. 0		

(*c*) TABLE VI.—*Percentage of cells with approximate constant specific gravity per month (group B batteries)*

Month:	Percentage cells	Month—Continued	Percentage cells
1st	28. 2	6th	16. 5
2d	18. 4	Average entire test (see enclosure 4) approximately	23.
3rd	22. 6		
4th	29. 8		
5th	20. 0		

c. Group C: New batteries treated with AD–X2.

(1) Total number of batteries in group C, all depots, at start of test was 50 or 150 cells. No battery failure was reported in this group during the first month. Two percent of the batteries failed the second, third, fourth, and fifth months. No failures occurred in the sixth and final month. Total failures during the entire test of new treated batteries were 4, or 8 percent, of the original amount. See enclosure 3.

(2) The following tables indicate the variations in specific gravity for group C battery cells:

(*a*) TABLE VII.—*Percentage of cells with higher specific gravity per month (group C batteries)*

Month:	Percentage cells	Month—Continued	Percentage cells
1st	36. 8	6th	26. 0
2d	36. 8	Average entire test (see enclosure 5) approximately	38.
3d	43. 0		
4th	39. 0		
5th	31. 0		

(*b*) TABLE VIII.—*Percentage of cells with lower specific gravity per month (group C batteries)*

Month:	Percentage cells	Month—Continued	Percentage cells
1st	41. 0	6th	56. 0
2d	44. 4	Average entire test (see enclosure 5) approximately	44.
3d	36. 0		
4th	37. 0		
5th	50. 0		

(*c*) TABLE IX.—*Percentage of cells with approximate constant specific gravity per month (group C batteries)*

Month:	Percentage cells	Month—Continued	Percentage cells
1st	22. 2	6th	18. 0
2d	18. 8	Average entire test (see enclosure 5) approximately	21.
3d	21. 0		
4th	24. 0		
5th	19. 0		

d. Group D: New batteries, untreated.

(1) Total number of batteries, all installations, at start of test in this group were 50 or 150 cells. There were no battery failures except in the fourth month. One battery failed in that month which was the only battery failure in this group for the entire test. Percentage of failures for group D, 2 percent. See enclosure 3.

(2) Tables of specific-gravity variations are as follows:

(a) TABLE X.—*Percentage of cells with higher specific gravity per month (group D batteries)*

Month:	Percentage cells	Month—Continued	Percentage cells
1st	30.0	6th	48.0
2d	35.0	Average, entire test (see enclosure 5), approximate	40.0
3d	49.0		
4th	37.0		
5th	44.0		

(b) TABLE XI.—*Percentage of cells with lower specific gravity per month (group D batteries)*

Month:	Percentage cells	Month—Continued	Percentage cells
1st	39.0	6th	38.0
2d	46.0	Average, entire test (see enclosure 5), approximate	41.0
3d	39.0		
4th	40.0		
5th	43.0		

(c) TABLE XII.—*Percentage of cells with approximate constant specific gravity per month (group D batteries)*

Month:	Percentage cells	Month—Continued	Percentage cells
1st	31.0	6th	14.0
2d	19.0	Average, entire test (see enclosure 5), approximate	19.0
3d	12.0		
4th	23.0		
5th	13.0		

10. All the batteries that were operating at completion of the 6 months test were removed from the vehicles and disassembled. Plates and separators were inspected and their condition recorded. Depth of sediment, or battery mud, was measured. Serviceability of each battery was classified as satisfactory or unsatisfactory in accordance with the condition of the plates and separators. Internal condition of a battery recorded as fair or better was classified as satisfactory, while batteries whose internal conditions were poor or worse were listed as unsatisfactory. The following table indicates the classification of all batteries that were still in operation at completion of the field test:

a. TABLE XIII.—*Percentage of satisfactory and unsatisfactory batteries after internal inspection at completion of final test*

Battery group	Satisfactory	Unsatisfactory
A	47	53
B	45	55
C	64	36
D	75	25

b. The sediment or battery mud at bottom of each battery cell was removed and placed in a jar. Plates of the cell were washed in water and water and sludge added to the same jar containing sediment of the particular cell. Depth of sediment was measured after elapse of 24 hours. The following table indicates average depth of sediment found in each cell of the four battery groups.

(1) TABLE XIV.—*Average depth of sediment in cells of batteries that were in operation at conclusion of test*

Battery group:	Average depth in inches
A	7/32
B	1/4
C	1/8
D	1/8

11. Results of field test indicate that the battery compound, AD–X2, formerly known as Protecto-Charge, was ineffective in restoring to active service the claimed approximately 70 percent of discarded sulfated batteries, that it extends the life of mechanically sound old batteries, or lengthens life expectancy of new batteries. The deductions are based on the following:

a. Forty six percent of the salvage batteries treated with AD–X2, group A, failed during subject test. The average number of cells in A group indicating a progressively higher specific gravity was approximately 34 percent, while approximately 42 percent of the cells were lower. If the 52 percent of the batteries in group A which were classified as unsatisfactory after completion of test, see table XIII, are considered as failures, the final percentages for the group of salvage batteries will be as follows:

	Percent
Percent of salvage batteries restored to active service	30
Failures	70

This is in sharp contrast to the claim that the use of AD–X2 will restore approximately 70 percent of discarded sulfated batteries to active service.

b. During the period of 6 months 26 percent of sound old batteries treated with AD–X2 in group B failed. Thirty-two percent of the cells in this group averaged higher specific gravity readings and approximately 45 percent were progressively lower.

c. According to an analysis of the tabulated data, life expectancy was not extended by use of AD–X2. For example, group C, composed of new treated batteries, showed a higher percentage of failures, 8 percent, than were recorded for the new untreated batteries in group D where only 2 percent failed. Further, a study of the percentage of specific gravity variations in the two groups of new batteries indicates a greater percentage of the untreated cells with progressively higher readings.

d. No effect in decreasing the amount of sediment, or battery mud, in cells was evident with the use of AD–X2. An equal amount of sediment was present in the cells of the new AD–X2 treated batteries and in the new untreated batteries. Reference to table XIV discloses that the average depth of sediment for groups C and D batteries was one-eight inch.

12. In conclusion, the subject field test does not substantiate the claims of the manufacturer relative to the effectiveness of the battery additive AD–X2, formerly known as Protecto-Charge.

13. It is recommended that the attached letter, Incl 6, be forwarded to the manufacturer of AD–X2.

F. G. Crabb, Jr.,
Colonel, Ordnance Department.

5 enclosures:
1. Letter of instructions initiating field test.
2. Monthly report form.
3. Graph of battery failures.
4. Graph of variations in specific gravity, groups A and B.
5. Graph of variations in specific gravity, groups C and D.
6. Letter to manufacturer of AD–X2—w/d.

To: OCO, attention: Field Service Division, Maintenance Branch, Auto Section.
Subject: Letter report on field service test of transport vehicle batteries containing Protecto-Charge.

1. Forwarded is information requested in basic letter, subject as above for month ending ----------.

Line No.	Vehicle nomenclature and United States registry No.	Battery type		Voltage reading from test	Number of times battery received charge this month	Specific gravity					Date battery was removed	Remarks
		Standard nomenclature	Types A, B, C, D			1st week	2d week	3d week	4th week	5th week		
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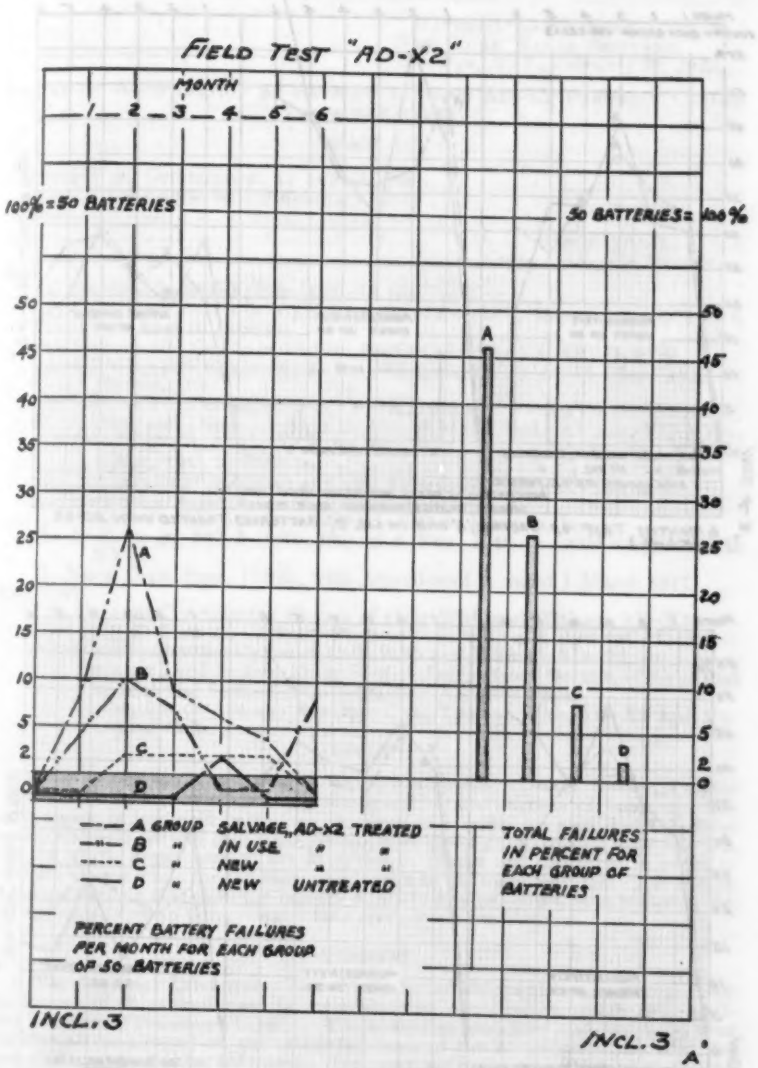
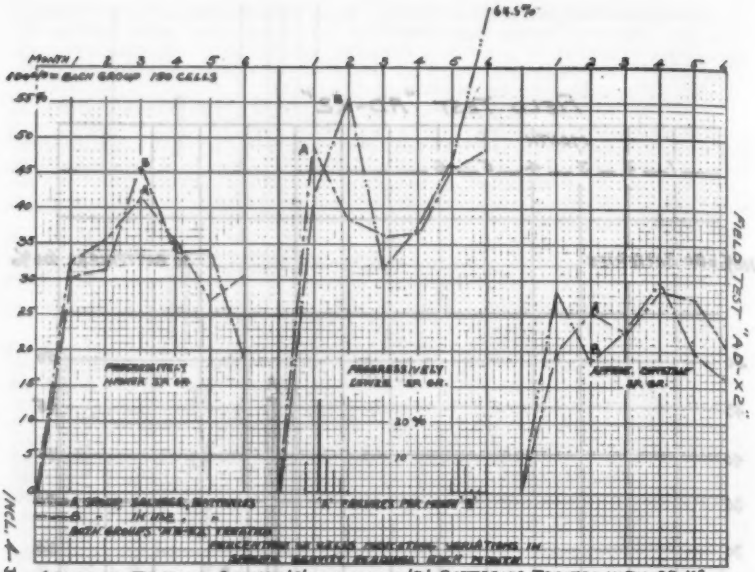
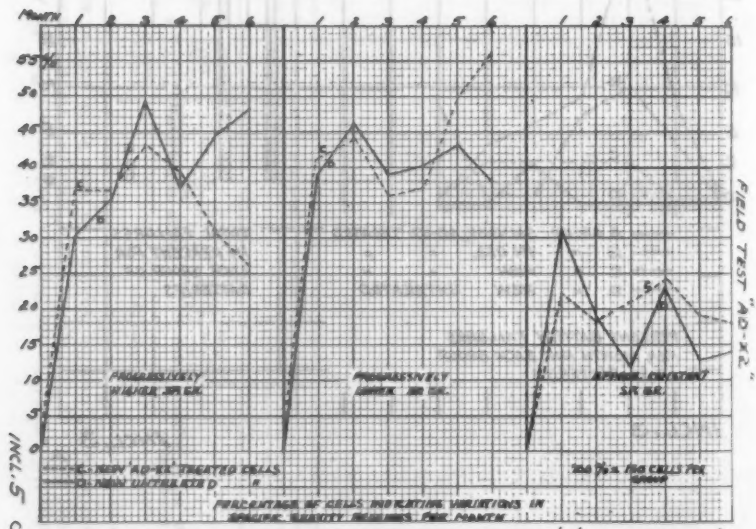


INCL. 3

INCL. 3 A



6 MONTHS TEST OF SALVAGE, 'A' AND IN USE, 'B,' BATTERIES TREATED WITH AD-X2 (INCL. 4 %)


MONTH 1 2 3 4 5 6
PROGRESSIVELY HIGHER SP. GR.
PROGRESSIVELY LOWER SP. GR.
APPROX. CRITICAL S.P. GR.
C. "AD-X2" TREATED CELLS
D. " UNTREATED "
PERCENTAGE OF CELLS INDICATING VARIATIONS IN SPECIFIC GRAVITY READINGS PER MONTH
FIELD TEST "AD-X2."
INCL. 5 %

6 MONTHS TEST OF NEW BATTERIES, TREATED WITH AD-X2, 'C' AND UNTREATED, 'D.'

EXHIBIT 12

REPORT NO. 5073, FINAL

MATERIAL LABORATORY,
NEW YORK NAVAL SHIPYARD,
Brooklyn, N. Y., February 23, 1949.

REPORT OF INVESTIGATION OF BATTERY ADDITIVE AD–X2 FORMERLY CALLED "PROTECTO-CHARGE"

NS–677–051

Investigation Commenced: 19 August 1948.
Investigation Completed: 9 February 1949.
Approved:

D. C. REDGRAVE, Jr.,
Capt., USN, The Director.

Ref:

(a) BuShips ltr S62–3 (660s–330), 15 Dec. 1947.
(b) COMNAVSHIPYD NYK ltr S62–3/L5–2(977), Report No. 5073 of 6 Jan. 1948 to BuShips.
(c) Embree and Co. ltr of 19 Feb. 1948 to COMNAVSHIPYD NYK.
(d) COMNAVSHIPYD NYK ltr S62–3/L5–2(977) of 11 Mar. 1948 to Pioneers, Inc.
(e) Embree and Company ltr of 19 Mar. 1948 to COMNAVSHIPYD NYK.
(f) Embree and Company ltr of 18 Aug. 1948 to COMNAVSHIPYD NYK.
(g) COMNAVSHIPYD NYK ltr S62–3/L5–2(977), Report No. 5073 of 8 Sept. 1948 to BuShips.
(h) BuShips ltr S62–3(660s) of 8 Oct. 1948 to Embree and Company.
(i) Pioneers, Inc. ltr of 13 Oct. 1948 to BuShips.
(j) BuShips ltr S62–3(660s) of 28 Oct. 1948 to Pioneers, Inc.
(k) BuShips ltr S62–3 (660s–330) of 8 Nov. 1948 to COMNAVSHIPYD NYK.
(l) Navy Dept. Spec. 17B4h, with Amendment 1, dated 1 March 1947.

Encl (hw):

(A) Data on Conditioning Charge of Cells With and Without AD–X2.
(B–1 to B–3) Data on Capacity Tests of Cells With and Without AD–X2.
(C) Data on Routine Cycles of Cells With and Without AD–X2.
(D) Data on Lead Sulfate Content of Sediment from Bottom of Cells and of Material Scraped from Surface of Negative Plates.
(E) Tabulation of Average Results—Cells Treated With AD–X2 and Untreated Cells.

ABSTRACT

This investigation deals with a battery additive AD–X2, formerly called "Protecto-Charge", which is being marketed for the purpose of improving the performance of lead-acid batteries. A group of severely sulfated, but otherwise sound, lead-acid battery cells was selected, part of the group treated with AD–X2, and the whole group worked for 51 cycles of charge and discharge in order to evaluate claims made for the battery additive by its manufacturer. The results indicated that, in this case, the battery additive was not effective in restoring the battery cells from an unserviceable to a serviceable condition.

AUTHORITY

1. The Material Laboratory, New York Naval Shipyard, was authorized by the Bureau of Ships, under ref. (a) to conduct an investigation on a battery additive known as "Protecto-Charge." The authorization letter also requested that the Bureau be advised on the estimated costs of the investigation, so that the manufacturer could be informed. The cost estimate was forwarded to the Bureau of Ships under ref. (b).

2. Reference (c) indicated that the manufacturer of "Protecto-Charge," Pioneers, Inc., 2411 Grove St., Oakland, California, had been advised of the cost of the investigation, and that Embree and Company, merchandise brokers of 110 Market Street, San Francisco, California, had agreed to underwrite the cost of the investigation.

3. In reply to reference (c), the manufacturer was notified by ref. (d) of the procedure to be followed in supplying the money and additional samples to supplement those received via the Bureau under ref. (a).

4. The manufacturer's agent, Embree and Company, forwarded to the Material Laboratory, under ref. (e), a check for $375.00 to cover the cost of the investigation, and additional samples of "Protecto-Charge" were received on 23 March 1948.

5. Work on the investigation was started at the Material Laboratory, New York Naval Shipyard, on 19 August 1948. A letter, ref. (f), was received on 23 August 1948, from the manufacturer's agent, requesting return of all samples, literature and money provided for the investigation. The Bureau of Ships was informed, by ref. (g), of the status of the investigation, and, in view of ref. (f), further instructions were requested.

6. The Bureau of Ships, under ref. (h), suggested continuation of the investigation at Government expense, using the samples of "Protecto-Charge" previously furnished by the manufacturer. In reply, the manufacturer, by ref. (i), indicated acceptance of continuation of the investigation at Government expense and outlined a procedure whereby the performance of batteries treated with "Protecto-Charge" be determined in operating vehicles. The Bureau of Ships' letter, ref. (j), indicated preference for controlled laboratory tests to show the validity of claims made for "Protecto-Charge."

7. The Bureau of Ships, by ref. (k), canceled the original authorization of ref. (a), and directed that the investigation be resumed at the Material Laboratory, New York Naval Shipyard, under a modified procedure which was specified. Ref. (k) also requested return of the exhibitor's deposit of $375.00, and directed that the investigation be performed at Government expense. The refund was made.

8. The Material Laboratory was informed by the exhibitor, in December 1948, that the name of the material had been changed from "Protecto-Charge" to "AD–X2."

9. The investigation was not witnessed by representatives of the manufacturer of AD–X2 (Protecto-Charge), or by other than Material Laboratory personnel.

OBJECT

10. The object of the investigation was to evaluate the claims made for a battery additive, by its manufacturer, in restoring badly sulfated but otherwise sound storage battery cells, of the lead-acid type, from an unserviceable to a serviceable condition.

DESCRIPTION

11. The battery additive AD–X2, formerly called "Protecto-Charge," consists of a whitish powder composed chiefly of magnesium sulfate and sodium sulfate. It is marketed in small packages, each containing a quantity of the material sufficient for a treatment, or part treatment of one cell, of a lead-acid type battery cell of the size commonly used in automobiles and trucks.

PROCEDURE

12. The batteries selected for the purpose of evaluating the claims made for the battery additive were four class 6V–SBMD–130AH of ref. (1). These batteries had been in an idle condition for approximately one year after completion of a test and their negative plates were in a severely sulfated condition. In order to remove possible short-circuits within the cells, all of the separators were removed and replaced with new separators. The new separators were porous rubber in batteries 1 and 4, and wood in batteries 2 and 3.

13. The four batteries were examined for condition of plates and amount of bottom sediment. Specimens of bottom sediment and of negative plate surface material were taken from each cell for analysis for lead sulfate. After new separators had been installed, the elements were reassembled into batteries and 1.100 specific gravity sulphuric acid electrolyte added to the level required to cover the plates.

14. The four batteries were partly treated with the battery additive and tested as follows:

(a) Two small packages of the battery additive were placed in each of two cells of each battery. The middle cell of each of two batteries and one end cell of each of two batteries were not treated with the additive. The electrolyte level of all cells was brought up to normal with distilled water and then the cells were charged at rate of 6 amperes for 37 hours. At this time period, specific

gravity readings, taken with a separate hydrometer for the cells with the battery additive, indicated that maximum specific gravity had not been attained. The charge was continued at rate of 12 amperes until maximum specific gravity was reached and then the electrolyte in each cell was adjusted to about 1.275 specific gravity. The quantity of the battery additive in the treated cells was not decreased during electrolyte adjustment, because the acid used had been mixed with a proportionate part of the additive, one package per 600 ml of acid.

(*b*) The capacity of each cell was determined separately on discharges at the 1-hour rate of 100 amperes to 1.65 volts, at the 10-hour rate of 17.5 amperes to 1.75 volts, from initial temperature of approximately 80° F., and at the engine cranking rate of 650 amperes to 1.00 volts from initial temperature of zero° F. Each discharge was followed by a recharge at 12 amperes to electrolyte maximum specific gravity for one hour, subject to the limitation that the total amount of charge was not to exceed 200 percent of the ampere hours delivered on the preceding discharge.

(*c*) The cells were cycled for 45 cycles, as specified under ref. (1) for batteries undergoing life test, with exception that the discharges were at 30 amperes instead of 100 amperes. This change was made to permit easier control of the rate, and because of low capacity in ampere-hours.

(*d*) The capacity cycles of preceding subparagraph (*b*) were repeated for cycles 49, 50, and 51.

15. The cells were opened and examined after completion of cycle 51. The condition of the plates was noted and bottom sediment in each cell was measured for depth. Samples were taken for analysis for lead sulfate content. These samples were taken from the top layer of sediment at the bottom of each cell, and from the material on the surface of negative plates.

16. A sample of AD–X2 was analyzed to determine its composition.

17. The lead sulfate content of sediment and negative plate material was determined as follows:

(*a*) Grinding the specimen to a fine texture.

(*b*) Washing the material with water to remove sulfuric acid and any other water soluble material.

(*c*) The material was dried and weighed. This weight was used as the basis for the entire analysis of dry and water-insoluble material.

(*d*) The dry material was treated with a mixture of concentrated ammonium acetate and hydrogen peroxide, and then filtered.

(*e*) The filtrate was acidified with hydrocholoric acid, treated with an excess of barium chloride solution, and again filtered.

(*f*) The residual material was ignited, dried, and weighed for recalculation into terms of lead sulfate.

RESULTS

18. *Initial condition of cells.*—The examination, after removal of separators, showed that the negative plates of each cell were fully pasted but that the normally active material was in a hard sulfated condition. The positive plates were in a fair condition, with about 80 percent of their normal amount of active material in a slightly hardened condition. Any excess of bottom sediment was removed so that the amount remaining in each cell was ¼ inch in depth. Cell voltages and electrolyte specific gravity readings before charging the cells were as follows:

Cell No.	Cell volts	Electrolyte specific gravity	AD–X2 added	Electrolyte specific gravity after adding AD–X2
1-1	1.04	1.098	Yes	1.133
1-2	1.38	1.090	No	
1-3	1.42	1.093	Yes	1.110
2-1	1.38	1.088	Yes	1.126
2-2	1.34	1.083	No	
2-3	1.36	1.066	Yes	1.104
3-1	1.43	1.064	Yes	1.093
3-2	1.26	1.077	Yes	1.107
3-3	1.42	1.078	No	
4-1	1.50	1.086	Yes	1.116
4-2	1.40	1.063	Yes	1.092
4-3	1.34	1.067	No	

NOTE.—Adding AD–X2 did not appreciably change cell voltages.

19. Data on the conditioning charge and electrolyte adjustment of the cells are given under enclosure (A).

20. Data on capacity tests of the cells are given under enclosures (B–1) to (B–3). Prior to capacity tests the cells were charged to maximum specific gravity for a period of one hour. The 1-hour and 10-hour rate discharges were preceded by a 12-hour stand period on open circuit. The discharges at 650 amperes from initial cell temperature of zero °F. were preceded by a 24-hour stand period on open circuit, during which time the cells were in a cold box whose temperature ranged from minus 5 degrees F. at start of the period to zero degrees F. at the end of the 24-hour period.

21. Data on representative routine cycles, taken at cycles 5, 25, and 45, are given under enclosure (C).

22. The lead-sulfate content of the sediment at the bottom of each cell, and of the surface material scraped from negative plates of each cell, at the start of the investigation and after completion of cycle 51 was as listed under enclosure (D).

23. Chemical analysis of the battery additive showed that it consisted of magnesium sulfate, 43.5 percent; sodium sulfate, 45.7 percent; water, 10.8 percent.

24. Condition of cells after completion of cycle 51 was as follows:

(*a*) Bottom sediment had increased from a depth of ¾-inch to an average depth of 1 inch in each cell of the four batteries. The top layer of sediment was lighter in color, indicating that some of it had come from negative plates.

(*b*) Negative plates were still in a severely sulfated condition. The normally active material was non-metallic when scraped, but softer than during the initial examination, with no appreciable difference between the cells treated with AD–X2 and those not treated with AD–X2.

(*c*) Positive plate active material was in a fairly soft condition in all cells. Positive plate grids in cells 1–1, 1–2, 1–3, 2–2, 3–1, 4–1, and 4–2 had suffered visible deterioration by peroxidation and their general condition had changed from fair to poor.

CONCLUSION

25. In order to evaluate the merits of the battery additive AD–X2 in restoring severely sulfated, but otherwise normal, lead-acid battery cells from an inoperative to a serviceable condition, a lot of 12 severely sulfated cells was selected, examined for other defects, the other defects corrected, two-thirds of the cells treated with AD–X2, all of the cells charged, electrolyte adjusted to a common value, and the performance of the treated and untreated cells obtained over a test period of 51 cycles of discharge and charge. Also, analyses for lead sulfate content were made of bottom sediment and of negative plate surface material, from samples taken before and after cycling the cells.

26. The average results of capacity tests, and of chemical analysis for sulfate content of bottom sediment and of material scraped from the surface of negative plates, at the start and completion of cycling operations on the cells treated with AD–X2 and on the cells not treated with AD–X2 are given under enclosure (E). Examination of the average results shows as follows:

(*a*) The capacity of the cells, on 1-hour rate discharges at 100 amperes, decreased during cycling operations, that of the cells treated with AD–X2 from 45 percent of rating at cycle 1 to 28 percent of rating at cycle 49, and that of the cells not treated with AD–X2 decreased from 45 percent of rating at cycle 1 to 32 percent of rating at cycle 49.

(*b*) On 10-hour rate discharges at 17.5 amperes, the capacity of the cells treated with AD–X2 decreased from 28 percent to 26 percent of rating, while the capacity of the cells not treated with AD–X2 increased from 26 percent to 31 percent of rating.

(*c*) Performance on discharges at 650 amperes from initial temperature of zero °F. was extremely poor. The cells treated with AD–X2 showed 4.0 percent of rated capacity at cycle 3 and 4.2 percent of rated capacity at cycle 51. The cells not treated with AD–X2 gave 4.0 percent of rated capacity at cycle 3 and 3.3 percent of rated capacity at cycle 51.

(*d*) The 30 ampere discharges represent performance on approximately 5-hour rate discharges. Capacity decreased as a result of cycling the cells, that of AD–X2 treated cells from 41.7 percent of rating at cycle 5 to 34.6 percent of rating at cycle 45, while that of cells not treated with AD–X2 decreased from 42.3 percent of rating at cycle 5 to 38.8 percent of rating at cycle 45.

(*e*) The lead-sulfate content of the top layer of bottom sediment in the cells increased during cycling operations. In the cells treated with AD–X2 the increase was from 24.1 percent to 35.8 percent, while in the cells not treated with AD–X2 the increase was less pronounced and from 24.3 percent to 25.5 percent.

(*f*) The lead sulfate content of material scraped from the surface of negative plates decreased during cycling of the cells. In the cells treated with AD–X2, the decrease was from 89.9 percent to 64.7 percent, while in the untreated cells the decrease was from 92.2 percent to 55.6 percent.

DISCUSSION

27. The results of this investigation indicate that the battery additive, AD–X2, formerly called "Protecto-Charge", was not effective in restoring a group of severely sulfated lead-acid battery cells to a normal, serviceable condition. This deduction is based on the following:

(*a*) The overall capacity performance of the cells treated with AD–X2 was less satisfactory than that of the cells not treated with AD–X2, on the basis of results of discharges at 17.5, 30, and 100 amperes.

(*b*) All of the cells, those treated with AD–X2 and those not treated with AD–X2, shed approximately the same amount of active material during the test period. One of the claims made by the manufacturer of AD–X2 is that it slowly decreases the amount of battery mud.

(*c*) The lead sulfate content of the additional material shed from the plates of cells during cycling operations was higher for the cells treated with AD–X2 than for the cells not treated with AD–X2.

(*d*) The amount of lead sulfate on the surface of negative plates, was reduced more by normal cycling operations than by treatment with AD–X2 followed by normal cycling operations.

(*e*) The results of discharges at 650 amperes from initial temperature of zero °F are discounted. Negative plate sulphation was too high, even after treatment with AD–X2, to permit satisfactory performance. The condition of positive plates, at start of the investigation, was judged to be good enough to permit development of 40 percent of rated capacity, whereas the maximum capacity developed by any cell was 15.2 percent of rating.

RECOMMENDATION

28. It is recommended that, as a result of this investigation, the battery additive AD–X2, formerly called "Protecto-Charge", be not approved for Naval use as a lead-acid battery restorer.

PERSONNEL

This investigation was conducted by P. A. Gruber, Electrical Engineer, supervisor of the Battery Project Section of the Material Laboratory, New York Naval Shipyard. Chemical analysis data were furnished by A. J. Finks, Chemist, of the General Chemistry Project Section.

Unless otherwise directed, within 14 days of forwarding date of this report, the investigation will be considered closed and any remaining materials scrapped.

ENCLOSURE (A)

Conditioning charge of class 6V–SBMD–130AH battery cells

Battery and cell number	Treated with AD–X2	Charge period A			Charge period B			
		37 hours at 6 amperes			27 hours at 12 amperes			
		End temperature °F.	End volts	End specific gravity	End temperature °F.	End volts	End specific gravity	Adjusted specific gravity to—
1-1	Yes	91	2.30	1.221	111	2.34	1.247	1.278
1-2	No	91	2.31	1.178	112	2.34	1.222	1.275
1-3	Yes	91	2.29	1.190	111	2.32	1.231	1.276
2-1	Yes	90	2.28	1.185	111	2.32	1.230	1.277
2-2	No	90	2.31	1.221	112	2.34	1.245	1.272
2-3	Yes	90	2.29	1.187	112	2.33	1.223	1.278
3-1	Yes	90	2.31	1.207	112	2.36	1.248	1.272
3-2	Yes	90	2.32	1.215	111	2.34	1.245	1.274
3-3	No	90	2.32	1.198	111	2.36	1.241	1.268
4-1	Yes	89	2.28	1.176	108	2.33	1.230	1.277
4-2	Yes	89	2.30	1.188	109	2.34	1.241	1.276
4-3	No	89	2.29	1.177	108	2.33	1.234	1.274

NOTE.—Charge voltages are not corrected for temperature. Charge during the electrolyte adjustment period was at 15 amperes for 10 hours.

ENCLOSURE (B–1)

Data on capacity tests, class 6V–SBMD–130AH battery cells, discharges at 1-hour rate of 100 amperes to 1.65 volts

Battery and cell number	Treated with AD–X2	Cycle 1			Cycle 49		
		Initial temperature, °F	Initial specific gravity	Capacity ampere-hours	Initial temperature, °F	Initial specific gravity	Capacity ampere-hours
1–1	Yes	83	1.268	63.3	82	1.251	36.7
1–2	No	83	1.256	48.3	84	1.246	38.3
1–3	Yes	83	1.252	31.7	82	1.259	20.0
2–1	Yes	82	1.250	10.0	80	1.269	21.7
2–2	No	82	1.250	24.0	83	1.260	30.0
2–3	Yes	82	1.261	30.8	82	1.252	26.7
3–1	Yes	81	1.259	64.5	80	1.247	28.3
3–2	Yes	82	1.250	83.3	83	1.236	38.3
3–3	No	82	1.255	60.9	80	1.242	35.0
4–1	Yes	80	1.250	23.8	80	1.255	23.3
4–2	Yes	80	1.258	58.3	81	1.248	31.7
4–3	No	80	1.250	50.3	81	1.241	26.7

ENCLOSURE (B–2)

Data on capacity tests, class 6V–SBMD–130AH battery cells discharges at 10-hour rate of 17.5 amperes to 1.75 volts

Battery and cell No.	Treated with AD–X2	Cycle 2			Cycle 50		
		Initial temperature ° F.	Initial specific gravity	Capacity ampere-hour	Initial temperature ° F.	Initial specific gravity	Capacity ampere-hour
1–1	Yes	80	1.259	82.5	80	1.235	56.0
1–2	No	82	1.235	41.4	81	1.234	62.7
1–3	Yes	80	1.231	23.9	81	1.235	34.4
2–1	Yes	80	1.233	0.6	81	1.253	37.9
2–2	No	82	1.240	8.8	82	1.247	44.1
2–3	Yes	80	1.235	19.0	81	1.236	46.7
3–1	Yes	80	1.248	79.3	80	1.232	46.7
3–2	Yes	82	1.250	91.6	80	1.222	56.9
3–3	No	80	1.237	64.8	80	1.227	51.9
4–1	Yes	80	1.226	12.3	81	1.240	44.1
4–2	Yes	81	1.249	84.6	82	1.231	46.7
4–3	No	80	1.236	64.5	81	1.222	59.4

ENCLOSURE (B–3)

Data on capacity tests, class 6V–SBMD–130AH battery cells discharges at 650 amperes to 1.00 volt at 0° F.

Battery and cell number	Treated with AD–X2	Cycle 3			Cycle 51		
		Initial specific gravity	5-second volts	Discharge time	Initial specific gravity	5-second volts	Discharge time
				Seconds			*Seconds*
1–1	Yes	1.268	1.35	30	1.255	1.30	30
1–2	No	1.260	1.28	10	1.255	1.18	12
1–3	Yes	1.253	1.15	7	1.265	1.12	10
2–1	Yes	1.251	----------	1	1.265	----------	1
2–2	No	1.252	----------	1	1.270	----------	1
2–3	Yes	1.254	----------	1	1.260	----------	1
3–1	Yes	1.271	----------	4	1.260	----------	1
3–2	Yes	1.270	----------	3	1.255	----------	1
3–3	No	1.255	----------	2	1.250	----------	3
4–1	Yes	1.251	----------	1	1.265	1.00	5
4–2	Yes	1.267	1.19	15	1.265	1.23	17
4–3	No	1.260	1.31	18	1.260	1.14	10

ENCLOSURE (C)

Data on routine cycles—Class 6V–SBMD–130AH battery cells, discharges at 30 amperes to 1.60 volts, charges at 12 amperes to 150 percent of ampere-hours obtained on previous discharge

Cell No.	Treated with AD–X2	Cycle 5				Cycle 25				Cycle 45			
		Charge, volts	Charge, specific gravity	Initial temperature, °F.	Capacity, ampere-hours	Charge, volts	Charge, specific gravity	Initial temperature, °F.	Capacity, ampere-hours	Charge, volts	Charge, specific gravity	Initial temperature, °F.	Capacity, ampere-hours
1–1	Yes	2.37	1.256	90	51	2.36	1.223	92	54	2.38	90	1.243	57
1–2	No	2.38	1.267	92	76	2.36	1.233	94	59	2.37	91	1.244	62
1–3	Yes	2.37	1.247	90	49	2.37	1.239	92	48	2.39	90	1.261	40
2–1	Yes	2.35	1.245	93	27	2.37	1.253	91	43	2.38	90	1.265	51
2–2	No	2.36	1.255	93	38	2.37	1.246	93	60	2.37	91	1.257	61
2–3	Yes	2.36	1.242	91	39	2.37	1.233	91	46	2.38	90	1.248	44
3–1	Yes	2.38	1.255	90	78	2.36	1.215	90	54	2.38	90	1.241	50
3–2	Yes	2.38	1.253	92	94	2.35	1.217	92	52	2.36	91	1.228	61
3–3	No	2.38	1.252	90	72	2.35	1.219	90	50	2.36	90	1.237	59
4–1	Yes	2.36	1.242	90	47	2.36	1.235	91	47	2.37	90	1.251	55
4–2	Yes	2.38	1.258	92	84	2.35	1.223	93	52	2.36	91	1.243	60
4–3	No	2.38	1.260	90	69	2.35	1.221	91	47	2.36	90	1.236	52

ENCLOSURE (D)

Class 6V–SBMD–130AH battery cells—Lead-sulfate content of bottom sediment and of negative plate surface material

Cell No.	Treated with AD–X2	Bottom sediment, lead sulfate		Negative plate surface, lead sulfate	
		Start	After cycle 51	Start	After cycle 51
		Percent	*Percent*	*Percent*	*Percent*
1–1	Yes	31.5	31.7	90.6	42.1
1–2	No	22.4	28.6	98.3	29.8
1–3	Yes	24.1	21.1	89.3	69.0
2–1	Yes	9.8	43.8	86.0	83.8
2–2	No	26.4	35.5	93.1	61.1
2–3	Yes	20.6	42.6	80.6	64.5
3–1	Yes	38.7	33.8	94.0	70.5
3–2	Yes	11.8	34.9	94.1	56.9
3–3	No	23.3	12.9	92.1	68.4
4–1	Yes	26.4	45.1	93.4	71.7
4–2	Yes	30.1	33.3	91.6	59.3
4–3	No	19.9	25.1	86.7	63.2

ENCLOSURE (E)

Comparison of results—cells treated with battery additive AD–X2 and untreated cells

	Cells treated with AD–X2		Untreated cells	
	Average at start	Average at end	Average at start	Average at end
Capacity on 100-ampere discharges	45.7 ampere-hours.	28.3 ampere-hours.	45.9 ampere-hours.	32.5 ampere-hours.
Capacity on 17.5-ampere discharges	49.2 ampere-hours.	46.2 ampere-hours.	44.9 ampere-hours.	54.5 ampere-hours.
Time on 650-ampere discharges at 0° F.	7.8 seconds	8.3 seconds	7.8 seconds	6.5 seconds.
Capacity on 30-ampere discharges	62.4 ampere-hours.	52.3 ampere-hours.	63.8 ampere-hours.	58.5 ampere-hours.
Lead sulfate in bottom sediment	24.1 percent	35.8 percent	24.3 percent	25.5 percent.
Lead sulfate on surface of negative plates.	89.9 percent	64.7 percent	92.6 percent	55.6 percent.

EXHIBIT 13

PROTECTO-CHARGE (AD–X2) LEAD-ACID BATTERY ELECTROLYTE ADDITIVE

Test Report No. T–1220—May 23, 1949

By Sylvia Alpert

Official:

GRENVILLE B. ELLIS,
Chief, Battery Branch.

Signal Corps Engineering Laboratories, Squier Signal Laboratory,
Fort Monmouth, N. J.

1. FOREWORD

(*a*) Correspondence dated September 10, 1947, from the Office of the Chief Signal Officer, file number SIGGG–C2, to these laboratories on the subject "Rejuvenation of Sulfated Storage Batteries," directed that an "authorized special investigation" be established for the purpose of determining whether Protecto-Charge (later AD–X2) warrants military use.

(*b*) The manufacturer and distributor of Protecto-Charge (AD–X2) recommended that their product, which they describe as a desulfating agent for wet batteries of the lead-acid type, be used on batteries that are sulfated but in a mechanically sound condition. They also recommend its use in new batteries for longer life.

(*c*) To properly test the effectiveness of Protecto-Charge (AD–X2), it became necessary to obtain or prepare batteries that were sulfated, yet mechanically sound With this in view, four groups of batteries were obtained for test as follows:

(1) Discarded, presumably sulfated, automotive batteries from Fort Monmouth salvage.

(2) New batteries (BB–221/U) from the Lexington Signal Depot. These batteries had been stored for about 4 years in a moist and uncharged condition, and were assumed to be sulfated.

(3) New batteries, Signal Corps types BB–54–A and BB–221/U, in a charged and dry condition.

(4) Two Air Corps batteries from Wright-Patterson Field (types 6–GT–9 and 6–GT–11) in a badly sulfated condition.

(*d*) Tests were conducted on these four groups of batteries, and the results with supporting literature and references are included in this report.

2. PURPOSE

Protecto-Charge (AD–X2) was tested by these laboratories in order to determine its value as an electrolyte additive for military type lead-acid storage batteries. It was also tested to evaluate the claims of its manufacturer, that it will restore badly sulfated, but otherwise sound, storage-battery cells of the lead-acid type from an unserviceable to a serviceable condition.

3. SUMMARY

(*a*) Tests conducted on batteries containing Protecto-Charge (AD–X2) by the Air Materiel Command at Wright-Patterson Field and the New York Naval Shipyard are in agreement with results obtained at these laboratories as indicated in the body of this report and in figure No. 9.

(*b*) Results of performance tests conducted at these laboratories on the four groups of batteries described under "Foreword" are given under "Discussion" and in figures Nos. 5 to 7.

(*c*) A chemical analysis of Protecto-Charge (AD–X2) was made at these laboratories. Such analyses had also been performed at other laboratories. Table No. I below shows the results obtained at SSL and at other laboratories.

Table No. I

[Percent]

	SSL	New York Naval Shipyard	Kenneth Bonnickson, chemist for Pioneers	Mare Island Naval Shipyard
Anhydrous $MgSO_4$	42.5	43.5	----------	40
Na_2SO_4	48.5	45.7	----------	45
Water of hydration	8.6	10.8	----------	15
Chlorine	Trace	----------	Nil	----------
Nitrate	Trace	----------	Nil	----------
Acetate	Nil	----------	Nil	----------
Iron	Nil	----------	Nil	----------
Copper	Nil	----------	Nil	----------
Mercury	Nil	----------	Nil	----------
Platinum	Nil	----------	Nil	----------
Arsenic	Nil	----------	Nil	----------

4. CONCLUSIONS

Tests which were conducted on the four groups of batteries noted under 1c above showed no significant differences in discharge characteristics between batteries treated with Protecto-Charge (AD–X2) and those which were untreated.

5. RECOMMENDATIONS

It is recommended that as a result of this investigation the battery additive, Protecto-Charge (AD–X2) not be approved for Signal Corps use. It is further recommended that when an investigation of a battery additive is requested in the future, its chemical composition be determined first, and if it contains any ingredient which has been previously tested by a reliable agency and found ineffective in improving battery performance, no long-term electrical tests be performed.

6. INTRODUCTION

(*a*) Protecto-Charge (AD–X2) is a white powder composed chiefly of magnesium sulfate and sodium sulfate. It is packaged in 3 small packages per box, each envelope containing sufficient material for the treatment of 1 cell of a 2-H size battery. In order to better evaluate its use as a battery additive it should be recognized that materials of this type are not new to the battery field. An article called Battery Hi-Ball, Epsom Salts Again Offered as Battery Aid, was published by the National Better Business Bureau, Inc., in September 1933. "Hi-Ball" (approximately 84.5 percent epsom salts and 15.5 percent ammonium alum) was exploited on a nationwide scale as a panacea for battery ailments. Some of the claims for it resemble those presented by the producers of Protecto-Charge (AD–X2) for their product. The Service Bulletin of the National Better Business Bureau, Inc., on March 16, 1949, contained an article called Battery Compounds and Solutions (see fig. No. 8) in which they quote an official statement dated March 9, 1949, from Dr. E. U. Condon, Director of the National Bureau of Standards, on the subject of battery additives or "dopes." Articles such as the two mentioned above were published to protect the public from ineffective and expensive materials which are being advertised and exploited as cure-alls for battery troubles.

(*b*) (1) Claims made for Protecto-Charge (AD–X2) by its manufacturer are as follows:

(a) Reduces harmful effects of sulfation.
(b) Reduces sulfation already formed on plates.
(c) Helps to remove battery mud from bottom of case.
(d) Increases ampere-hour capacity of battery under starter conditions.
(e) Helps prevent freezing.
(f) Adds many months of use to batteries that would be otherwise discarded due to sulfation.
(g) Protecto-Charge contains no acid, no epsom salts, nor any other material known to be injurious to storage batteries of the lead-acid type.

(2) Pioneers, Inc., also claim that if Protecto-Charge (AD–X2) is added to new batteries, there is less chance of sulfation, and the battery will have longer life.

(*c*) Tests were made at these and other laboratories to verify the validity of the above-mentioned claims. The following are some of the results:

(1) Protecto-Charge does not reduce sulfation, nor does it remove battery mud from the bottom of the case (see fig. No. 9).

(2) The available capacity of a Protecto-Charge (AD–X2) treated battery is not increased under starter conditions even at lower temperatures, nor does the use of this additive insure longer life. Tests at these laboratories on low-temperature cranking discharges (300 amperes at 0° F.) conducted at intervals during a cycle life test on automotive type batteries gave similar capacities for both treated and untreated batteries even after 94 cycles of test (see fig. No. 6).

(3) Electrolyte of 1.280 specific gravity sulfuric acid in a storage battery meets military requirements for low-temperature operation in that it will withstand temperatures down to —90° F., when the battery is in a fully charged condition. The claim that Protecto-Charge (AD–X2) helps prevent freezing is of doubtful value in this case.

(4) Protecto-Charge (AD–X2) may contain no ingredients that are injurious to the lead-acid battery. It does not, however, improve battery performance (see Discussion).

(*d*) Included in the correspondence received from Pioneers, Inc., were testimonials from city government departments and private companies to the effect that Protecto-Charge (AD–X) was being used successfully in the batteries of their trucks and cars. The effectiveness of this product and an evaluation of the claims made for it cannot be accurately determined in this way since battery failure may be due to many causes. Performance tests at these laboratories were all conducted under controlled conditions. This is common practice at research laboratories, for in this manner an exact knowledge of what can be expected of a battery under all conditions can be obtained.

7. PROCEDURE

Protecto-Charge (AD–X2) was added to each cell in accordance with the manufacturer's directions on the package.

(*a*) The batteries recovered from salvage (2 each treated with Protecto-Charge (AD–X2) and 2 each untreated) were cycled 4 times at room temperature (80° F.

±5° F.). The charge rate used on the batteries was 6 amperes, and the discharges were conducted at 20 amperes (5-hour rate).

(*b*) The batteries obtained from the Lexington Signal Depot were filled and charged in accordance with manufacturer's instructions for batteries of this type. They were filled with sulfuric aicd electrolyte of 1.345 specific gravity and given an extended charge at 6 amperes. They were then discharged at 20 amperes at room temperature (80° F.±5° F.). All the batteries met their rated capacity on the first discharge, giving no evidence of being sulfated. Treatment with Protecto-Charge (AD–X2) were therefore considered unnecessary.

(*c*) The charged and dry batteries, BB–54–A and BB–221/U, were activated and cycled in accordance with the enclosed test procedure (fig. No. 4).

(*d*) (1) The fourth group of batteries consisted of 2 badly sulfated, 6-cell Air Corps batteries, types 6–GT–9 and 6–GT–11, received from the Air Materiel Command at Wright-Patterson Field, Dayton, Ohio. An attempt had been made by AMC to recover battery 6–GT–89 prior to its receipt at these laboratories. They had filled the battery to the proper level with distilled water, added an envelope of Protecto-Charge (AD–X2) to cell No. 6 and charged the battery for 14 hours at 30 amperes, and 40 hours at 5 amperes. After the charge, no capacity was obtained from any of the cells.

(2) At these laboratories the electrolyte levels of both batteries were adjusted to normal by the addition of distilled water and given a charge of 126 ampere-hours at 3 amperes and 71 ampere-hours at 0.50 ampere. No changes in specific gravity or voltage were observed in either battery during the entire charge period. Two cells of battery 6–GT–9 (1 previously treated with Protecto-Charge (AD–X2), and 1 untreated) were then disassembled and reassembled into new cases with new separators to insure mechanical soundness. After another 68 ampere-hours of charge, no results were obtained so an additional envelope of Protecto-Charge (AD–X2) was added to the treated cell. The cells were again put on charge (0.20 ampere) for an additional 100 ampere-hours. Both voltage and specific gravity of the electrolyte in both cells showed no significant change during this charge. The test was, therefore, discontinued.

8. DISCUSSION

(*a*) The batteries discarded at Fort Monmouth salvage were cycled four times but no significant differences were found in capacity in those treated with Protecto-Charge (AD–X2) as compared with those containing sulfuric acid only (see fig. No. 5).

(*b*) The uncharged and moist batteries from Lexington Signal Depot met their rated capacity on the first discharge. It was, therefore, unnecessary to treat any of them with Protecto-Charge (AD–X2).

(*c*) Results of tests on new batteries treated and untreated with Protecto-Charge (AD–X2) are shown in figures Nos. 6 and 7. No significant differences were observed in the performance of treated and untreated batteries.

(*d*) The Air Materiel Command at Wright-Patterson Field were not able to recover battery 6–GT–9 after 620 ampere-hours of charge. At these laboratories both battery 6–GT–9 and 6–GT–11 received 197 ampere-hours of charge, but no changes in specific gravity and voltage were observed. Following this, 2 of the cells from battery 6–GT–9 (1 previously treated with Protecto-Charge (AD–X2) and 1 untreated) were reassembled in new cases with new separators to insure mechanical soundness. An additional 68 ampere-hours of charge, effected no improvement in either cell. An envelope of Protecto-Charge was then added to the previously treated cell and both cells given a further 100 ampere-hours of charge. Both cells still failed to accept the charge and the test was discontinued.

(*e*) It is concluded that batteries that are very badly sulfated cannot be recovered either with or without the addition of Protecto-Charge (AD–X2). It has also been determined that no improvement in the performance characteristics of storage batteries for military use may be expected by the addition of Protecto-Charge (AD–X2)

SYLVIA ALPERT,
Chemist, Battery Branch, SSL.

Reviewed by:

ARTHUR F. DANIEL,
Chief, Battery Development Section,
Squier Signal Laboratory.

SQUIER SIGNAL LABORATORY, BATTERY BRANCH,
BATTERY DEVELOPMENT SECTION,
Date: 22 January 1948.

Memorandum for: Battery Test Section.
Object: Test Procedure for Battery BB–221/U. Test No. S 192A.

1. Unless specified otherwise, all charges are to be run at 80° F. as follows:
Charge using starting rate of 15 amperes until three consecutive values of voltage and specific gravity taken at ½-hour intervals show no increase or until cells are gassing freely and finish at 6 amperes until three consecutive values of voltage and specific gravity taken at ¼-hour intervals show no increase.

2. Discharge Rate:

Discharge rate	Hourly rate	Current drain in amperes	Discharge rate	Hourly rate	Current drain in amperes
No. 1			No. 6	1-hour rate	
No. 2	40-hour rate		No. 7	20-minute rate	
No. 3	20-hour rate	6	No. 8	Cranking	300
No. 4	10-hour rate		No. 9		
No. 5	5-hour rate	20	No. 10		

3. All discharges are to be run to 1.7 volts per cell, unless otherwise indicated.

4. Readings should be taken at such intervals that at least 10 readings are taken for each half of a cycle. Specific gravity readings should be taken at the same intervals whenever possible.

5. All unusual developments during the test should be brought to the attention of the storage battery group as soon as noticed. Further testing of the battery should be discontinued until the test procedure has been revised.

6. The information on the attached sheets (No. of additional sheets 2) form part of this memorandum and give the cycling to be followed for each of the batteries. All tests to be run are indicated by a cycle number.

STORAGE BATTERY GROUP.

Approved by:

ARTHUR F. DANIEL,
Chief, Battery Development Section.

Test No. S–192A

TEST PROGRAM FOR BATTERIES NOS. 1, 2, 3, AND 4

(NOTE.—A. Batteries 3 and 4 contain "Protecto-Charge"); B. All batteries are new.

1. Preparation (cycle No. 1): Fill with 1.280 specific gravity electrolyte corrected to 80° F. "Protecto-Charge" is to be added to Batteries 3 and 4 in quantities to be specified at time of activation. Allow batteries to stand 1–4 hours at 80° F. and discharge at rate No. 3 at 80° F. to 5.25 volts.

2. Following is the procedure to be followed for Batteries 1, 2, 3, and 4. (Five second voltage readings should be recorded on all 300-ampere discharges):

Cycle No.	Discharge rate No.	Temperature °F.	End voltage	Cycle No.	Discharge rate No.	Temperature °F.	End voltage
2–4	3	80	5.25	13	3	−40	5.25
5	8	0	3.0	14–15	3	80	5.25
6	3	80	5.25	16	3	−40	5.25
7	3	−40	5.25	17	3	80	5.25
8–9	5	80	5.25	18	8	0	3.0
10	5	−40	5.25	19–20	3	80	5.25
11–12	3	80	5.25				

3. Storage test, cycle No. 21–22: After discharge on cycle 20 leave batteries in a discharge condition and store batteries at 130° F. for 3 months. Charge at 80° F. using finishing rate of 6 amperes until three consecutive values of voltage and specific gravity taken at ½-hour intervals show no increase. Discharge at rate No. 3 at 80° F. to 5.25 volts. Charge at 6 amperes as above and again discharge at rate No. 3 at 80° F. to 5.25 volts. (Notify Storage Battery Subsection at start of cycle No. 21.)

4. Cycles No. 23–41: I epeat cycles No. 2–20 in paragraph 2 above.

Test No. S–192A

TEST PROGRAM FOR BATTERIES NOS. 5, 6, 7, AND 8

(NOTE.—A. Batteries Nos. 7 and 8 contain "Protecto-Charge"); B. All batteries are new.

1. Preparation (cycle No. 1): Fill with 1.280 specific gravity electrolyte corrected to 80° F. "Protecto-Charge" is to be added to Batteries Nos. 7 and 8 in quantities to be specified at time of activation. Allow batteries to stand 1–4 hours at 80° F. and discharge at rate No. 3 at 80° F. to 5.25 volts.

2. Cycles No. 2–4: Discharge at rate No. 3 at 80° F. to 5.25 volts.

3. Retention of charge tests: Discharges are to be run at 80° F. at rate No. 3 after the storage periods indicated. Storage is to be at 80° F.

Cycle No. 5: Storage time, 1 month.
Cycle No. 6: No storage.
Cycle No. 7: Storage time, 3 months.
Cycle No. 8: No storage.

4. Life test: Starting with the 9th cycle, follow schedule A of paragraph F–22a in Signal Corps tentative specification No. 70–400, allowing for a cold test (300 amperes at 0° F. to 3.0 volts) on the 9th cycle. Omit every third capacity discharge and substitute in its place a 300-ampere discharge at 0° F.

SQUIER SIGNAL LABORATORY, BATTERY BRANCH,
BATTERY DEVELOPMENT SECTION,
Date: 22 January 1948.

Memorandum for: Battery Test Section.
Object: Test procedure for battery BB–54–A. Test No. 192B.

1. Unless specified otherwise, all charges are to be run at 80° F. as follows:
Charge using starting rate of 3.5 amperes until three consecutive values of voltage and specific gravity taken at ½-hour intervals show no increase or until cells are gassing freely and finish at 1.4 amperes until three consecutive values of voltage and specific gravity taken at ½-hour intervals show no increase.

2. Discharge rate:

Discharge rate	Hourly rate	Current drain in amperes	Discharge rate	Hourly rate	Current drain in amperes
No. 1			No. 6	1-hour rate	
No. 2	40-hour rate		No. 7	20-minute rate	
No. 3	20-hour rate	1.4	No. 8		
No. 4	10-hour rate		No. 9		
No. 5	5-hour rate	5.0	No. 10		

3. All discharges are to be run to 1.7 volts per cell, unless otherwise indicated.

4. Readings should be taken at such intervals that at least 10 readings are taken for each half of a cycle. Specific-gravity readings should be taken at the same intervals whenever possible.

5. All unusual developments during the test should be brought to the attention of the Storage Battery Group as soon as noticed. Further testing of the battery should be discontinued until the test procedure has been revised.

6. The information on the attached sheets forms part of this memorandum and give the cycling to be followed for each of the batteries. All tests to be run are indicated by a cycle number.

STORAGE BATTERY GROUP.

Approved by:

ARTHUR F. DANIEL,
Chief, Battery Development Section.

Test No. S–192B

PROGRESS FOR BATTERIES NOS. 1, 2, 3, AND 4

(NOTE.—A. Batteries Nos. 3 and 4 contain "Protecto-Charge"); B. All batteries are new.

1. Preparation (cycle No. 1): Fill with 1.280-specific-gravity electrolyte corrected to 80° F. "Protecto-charge" is to be added to Batteries 3 and 4 in quantities

to be specified at time of activation. Allow batteries to stand 1–4 hours at 80° F. and discharge at rate No. 3 at 80° F. to 1.75 volts.

2. Following is the procedure to be followed for Batteries 1, 2, 3, and 4.

Cycle Nos.	Discharge rate	Temperature °F.	End voltage	Cycle Nos.	Discharge rate	Temperature °F.	End voltage
2 to 4	3	80	1.75	11	3	−40	1.75
5	3	−40	1.75	12 and 13	5	80	1.75
6 and 7	5	80	1.75	14	5	−40	1.75
8	5	−40	1.75	15 and 16	3	80	1.75
9 and 10	3	80	1.75				

3. Storage Test, cycle Nos. 17–18: After discharge on cycle 16 leave batteries in a discharge condition and store batteries at 130° F. for 3 months. Charge at 80° F. using finishing rate of 1.4 amperes until three consecutive values of voltage taken at ½ hour intervals show no increase. Discharge at rate No. 3 at 80° F. to 1.75 volts. Charge at 1.4 amperes as above and again discharge at rate No. 3 at 80° F. to 1.75 volts. (Notify Storage Battery Subsection at start of cycle No. 17).

4. Cycles Nos. 19–33: Repeat cycles Nos. 2–16 in paragraph 2 above.

Test No. S–192B

PROGRAM FOR BATTERIES NOS. 5, 6, 7, AND 8

(NOTE.—A. Batteries Nos. 7 and 8 contain "Protecto-Charge"; B. All batteries are new.

1. Preparation (cycle No. 1): Fill with 1.280-specific-gravity electrolyte corrected to 80° F. "Protecto-Charge" is to be added to Batteries Nos. 7 and 8 in quantities to be specified at time of activation. Allow battery to stand 1–4 hours at 80° F. and discharge at rate No. 3 at 80° F. to 1.75 volts.

2. Cycles Nos. 2–4: Discharge at rate No. 3 at 80° F. to 1.75 volts.

3. Retention of charge tests: Discharges are to be run at 80° F. at rate No. 3 after the storage periods indicated. Storage is to be at 80° F.

Cycle No. 5: Storage Time, 1 month.
Cycle No. 6: No storage.
Cycle No. 7: Storage Time, 3 months.
Cycle No. 8: No storage.

4. Life test: Starting with the 9th cycle, follow schedule A of paragraph F–22a in Signal Corps tentative specification No. 70–400.

2–H type batteries obtained from Fort Monmouth salvage

[Capacity in ampere-hours]

Cycle	No Protecto-Charge		Protecto-Charge	
	Battery No. 1 (Delco)	Battery No. 2 (Auto-Lite)	Battery No. 3 (Willard)	Battery No. 4 (Delco)
1	100	70	82	54
2	90	64	75	45
3	107	75	92	54
4	88	70	84	42

Rated voltage: 6 volts.
Rated capacity: 120 A. H. at 20-hour rate.
Charge rate: 6 amperes.
Discharge rate: 20 amperes.
Temperature: 80°F. ± 5°F.
End voltage: 1.75 volts/cell.

Signal Corps battery BB–221/U (charged and dry)

[Capacity in ampere-hours]

Protecto-Charge					No Protecto-Charge					Remarks
6-ampere drain	20-ampere drain	40-ampere drain	300-ampere drain		6-ampere drain	20-ampere drain	40-ampere drain	300-ampere drain		
			Minimum to 3 volts	5-seconds voltage				Minimum to 3 volts	5-seconds voltage	
126.29	111.3	----	----	----	113.02	102.7	----	----	----	Discharged at 80° F.
----	----	----	5.58	4.30	----	----	----	4.95	4.15	Discharged at 0° F.
37.62	----	----	----	----	36.75	----	----	----	----	Discharged at −40° F.
94.90	----	----	----	----	95.0	----	----	----	----	Charged and discharged at 80° F. after 3 months storage in a discharged condition at 130° F.
103.71	----	----	----	----	103.47	----	----	----	----	Stored in charged condition for 1 month at 80° F., then discharged at 80° F.
53.23	----	----	----	----	64.10	----	----	----	----	Stored in charged condition for 3 months at 130° F., then discharged at 80° F.
----	----	----	4.61	4.03	----	----	----	4.60	4.36	After 94 cycles (SAE test) discharged at 0° F.
----	----	70	----	----	----	----	79.6	----	----	After 150 cycles (SAE test) discharged at 80° F.

Manufacturer: T. A. Edison, Inc.
Rated voltage: 6 volts.
Rated capacity: 120 ampere-hours at 20-hour rate.
Charge rate: Initial, 15 amperes; final, 6 amperes.
End voltage: (6, 20, and 40 ampere drain) = 5.25 volts.
End voltage: (300 ampere drain) = 3.0 volts.

Signal Corps battery BB–54–A (charged and dry)

[Capacity in ampere-hours]

Protecto-Charge			No Protecto-Charge			Remarks
1.4-ampere drain	4.5-ampere drain	5-ampere drain	1.4-ampere drain	4.5-ampere drain	5-ampere drain	
33.29	----	24.44	33.75	----	25.14	Discharged at 80° F.
8.02	----	4.22	8.10	----	4.05	Discharged at −40° F.
30.23	----	----	31.50	----	----	Charged and discharged at 80° F., after 3 months storage in a discharged condition at 130° F.
30.73	----	----	29.91	----	----	Stored in charged condition for 1 month at 80° F., then discharged at 80° F.
24.02	----	----	24.43	----	----	Stored in charged condition for 3 months at 80° F., then discharged at 80° F.
----	15.55	----	----	14.22	----	After 288 cycles, discharged at 80° F.

Manufacturer: Willard Storage Battery Co. Rated voltage: 2 volts. Rated capacity: 28 ampere-hours, at 20-hour rate. Charge rate: Initial, 3.5 amperes; final 1.4 amperes. End voltage: 1.75 volts.

[EXHIBIT 14]

REPORTS SUBMITTED BY JACK W. WALKER, MATERIAL ENGINEER, MCCLELLAN AIR FORCE BASE, SACRAMENTO AIR MATERIEL AREA, SACRAMENTO CALIF., IN CONNECTION WITH HIS TESTIMONY BEFORE THE SENATE SMALL BUSINESS COMMITTEE ON JUNE 25, 1953, AD–X2 HEARINGS

HQS AMC WRIGHT PATTERSON AF BASE,
Dayton, Ohio, May 18, 1948.

COMMANDING GENERAL,
Sacramento Air Material Area, Sacramento, Calif.

MCMMXC–12–5—182.

Project P–893–SC is assigned your depot for the service testing of automotive-type batteries treated with "Protecto-Charge."[1] This project is to service test "Protecto-Charge" which is manufactured by Pioneer, Inc., 2411 Grove Street, Oakland 12, Calif., and distributed by Embree & Co., 110 Market Street, San Francisco 11, Calif. In order to accomplish the project you are advised to select from salvage, disposal or reparable stock at your depot 5 each 6-volt and 5 each 12-volt batteries (mechanically sound old batteries) on which recharging has failed to return batteries to a serviceable condition. These batteries should be free of decomposed or buckled plates, split separators, broken cases or terminals, or any other deficiency which may attribute to a short circuit in a cell. Removal of battery mud on bottom of case of sulfate from the plates is not required, as it is the purpose of "Protecto-Charge" to dissolve these materials and return the battery to a serviceable condition. Obtain 1 each 12-volt new battery from class 19C stock and add electrolyte. If new batteries are not available from local stock, they should be procured locally in order to expedite the test. Authorization is granted your depot to directly contact the distributing agency for "Protecto-Charge" for the necessary materials required and pertinent technical data covering application of this project. Mr. Charles F. Embree, representative of Embree & Co., during his recent visit to the headquarters, signified his willingness to furnish, at no cost to the Government, sufficient quantities of "Protecto-Charge" to accomplish a service test on the above-mentioned batteries. Instructions to be followed in the accomplishment of this project are as indicated in attached instruction sheet. Request status of the project be reported semimonthly in accordance with AMC Reg 15–66–14.

ALBERT V. ENDRESS,
Colonel, USAF, Chief, Control Section,
Maintenance Division.

Distr: MTD.
Deg: MAP–4.
Map action: MSX.
Map 2: SCO.
MSH:

1 Enclosure: Instructions for the testing of "Protecto-Charge" on automotive-type batteries. Deg action.

INSTRUCTIONS FOR THE TESTING OF "PROTECTO-CHARGE" ON AUTOMOTIVE-TYPE BATTERIES

1. Identification of batteries will be as follows and tagged accordingly:

	6-volt	12-volt		6-volt	12-volt
New batteries	A–6	A–12	Old batteries (continued)	D 6	D–12
Old batteries	B–6	B–12		E–6	E–12
	C–6	C–12		F–6	F–12

2. Clean battery and terminals, cover plates of the battery with water and empty one envelope of "Protecto-Charge" into each cell. Dissolve the material on top of battery plates with battery syringe. Recharge at a rate of approximately 4 amperes and return battery to a specific gravity of not less than 1.225 or more than 1.280; 1.280 specific gravity should not be exceeded.

[1] Protecto-Charge: Former trade-mark of AD–X2.

3. Install the new batteries and 4 each of the 6- and 12-volt old batteries in vehicles subjected to heavy duty operation for which repeated startings of engines are necessary.

4. One each of the old 6-volt and old 12-volt batteries is to be stored and not installed in vehicles while service test is in progress.

5. Once every 15 days, each battery will be checked for general condition, the presence of deposits on top of battery, and the specific gravity of electrolyte in each cell. In addition to this check 1 each of the old installed 6-volt and 12-volt batteries will be subjected each 15-day period to extra heavy load until starting motor shows evidence of heating or battery failure is indicated.

(*a*) Tests should be conducted over a period of 120 days, whereupon the necessity for continuation of the test will be determined based on the results obtained.

(*b*) It is not considered necessary for headquarters personnel to assist in the installation and operation of this service test unless required by your depot.

(*c*) A service test report containing detailed findings of each 15-day inspection will be prepared by battery identification and will be furnished this headquarters. Comments and recomendations should be provided by your depot. Send two copies of each report to this headquarters, attention: MCMMXT53.

(*d*) Batteries used for this service test will be continued in service provided failure has not occurred during the period of service test. In each case of failure disposition of batteries will be made in accordance with administrative practices.

HEADQUARTERS,
SACRAMENTO AIR MATERIAL COMMAND,
McClellan Field, Calif., July 15, 1948.

Subject: Status and information of assigned project P–893–SC.
To: Commanding General, Air Material Command, Wright-Patterson Air Force Base, Dayton, Ohio. Attention: MCMMXC–12–5–182.

1. Batteries in this and future correspondence will be referred to as follows:
(*a*) 6VA (as of this date unassigned).
(*b*) 6VB (as of this date unassigned).
(*c*) 6VC (assigned to Jeep No. 20196194).
(*d*) 6VD (assigned to Michigan TM–16 power crane No. W–0098361).
(*e*) 6VE (stored on shelf for service test).
(*f*) 6VF (assigned to Jeep No. 20368381).
(*g*) 12VA (assigned to Weapon Carrier No. 2293388S).
(*h*) 12VB (assigned to Battery Test Cart No. 26772).
(*i*) 12VC (assigned to Truck-Tractor No. 531074).
(*j*) 12VD (assigned to Semitrailer F–1 Refueler No. W–0107157).
(*k*) 12VE (Michigan TM–16 Crane No. W0098361).
(*l*) 12VF (stored on shelf for service test).

2. Service test and data of the following batteries:

(*a*) 6VA: New dry charged battery, type 7–H, Surrette battery, strap date GRX–H–25. Filled with 1.275 acid, cooling time 5 hours. On charge 1900 June 1, 1948, of line 0800 June 7, 1948; with a specific gravity of 1.280 high, 1.275 low, voltage +2.4, −2.4. Charging time 60 hours drawing 2 amperes at finish. Specific gravity check June 9, 1948, 1.275 high, 1.270 low; June 14, 1948, 1.280 high, 1.275 low. As of this date unassigned.

(*b*) 6VB: Condemn battery (sulfated), type 7–H, Bowers battery, strap date H–4 (August 1944). Wood separators, uncharged and moist condition. On charge 1400 June 2, 1948, treated with "Protecto-Charge" 1500 June 2, 1948, off charge 0830 June 7, 1948, with a specific gravity of 1.280 high, 1.275 low, voltage +2.4, −2.4. Charging time 59 hours drawing 1 ampere at finish. Specific gravity check June 9, 1948, 1.275 high, 1.270 low; June 14, 1948, 1.280 high, 1.275 low. As of this date unassigned.

(*c*) 6VC: Condemn battery (plates showed sulfation), type 2–H, Globe battery, strap date March 1944. Rubber separators, little mud in bottom. On charge 1400 June 2, 1948, treated with "Protecto-Charge" 1500 June 2, 1948, off charge at 0830 June 7, 1948, with a specific gravity of 1.280 high, 1.275 low, voltage +2.4, −2.4, charging time 59 hours drawing 2 ampheres at finish. Specific gravity check June 9, 1948, 1.275 high, 1.270 low; June 14, 1948, 1.275 high, 1.270 low. Installed in jeep June 17, 1948, specific gravity 1.275 high, 1.270 low. One-minute starter run test. June 25, 1948, specific gravity check 1.285 high, 1.275 low, temperature 96° F. Ran starter motor and lights constantly for

7 minutes. Starter motor showed evidence of excessive heating at this time. Engine was still turning at a very good starting RPM, specific gravity check immediately after break-down test was 1.270 high, 1.260 low, temperature 100° F., connecting terminals cool. After 5-minute time period to allow the electrolyte to balance, specific gravity 1.255 on all 3 cells, temperature 100° F. Turned ignition system on and started engine, starter motor had very good turnover speed, engine started in approximately 5 revolutions, generator charge rate indicator 20 amperes. Battery showed no sign of breakdown.

(*d*) 6VD: Condemn battery (sulfated bad), type 4–H, Globe battery, no strap date. Battery was reinsulated with wood separators. On charge 1500 June 2, 1948, treated with "Protecto-Charge" 1530 same date, off charge 1430, June 8, 1948, with a specific gravity of 1.285 high, 1.280 low, voltage +2.4, −2.5, charging time 63 hours drawing 2 amperes at finish. Specific gravity check June 9, 1948, 1.285 high, June 14, 1948, 1.290 low. Installed in Michigan crane June 18, 1948, with specific gravity of 1.280 at 70° F.

(*e*) 6VE: Condemn battery (sulfated), type 4–H, Willard battery, no strap date. Wood separators, negative plates were soft and sandy, positive plates sulfated with a few small cracks, little mud in bottom of case. On charge 1400 June 2, 1948, treated with "Protecto-Charge" 1500 same date, off charge 0830 June 7, 1948, with a specific gravity of 1.280 high, 1.275 low, voltage +2.4, −2.4, charging time 59 hours drawing 2 amperes at finish. Specific gravity check June 9, 1948, 1.280 high, 1.270 low, June 14, 1948, 1.275 high, 1.260 low, June 18, 1948, 1.260 high, 1.240 low. On June 18, 1948, discharged battery for 19½ minutes to a terminal voltage of 4.5 at 200 amperes. On charge 1300 June 18, 1948, off line June 22, 1948, with a specific gravity of 1.285 high, 1.280 low, discharged battery for 18 minutes to a terminal voltage of 4.5 at 300 amperes. On charge 1500 June 24, 1948, off line June 29, 1948, with a specific gravity of 1.275 high, 1.270 low, voltage +2.5, −2.5, temperature 75° F. drawing 4 amperes at finish. June 29, 1948, stored on shelf for service test.

(*f*) 6VF: Stored battery, type 1–M, Auto-Lite battery, strap date November 1945, would not hold charge, filled with 1.345 acid June 2, 1948. On charge 0830 June 3, 1948, treated with "Protecto-Charge" same date, off line June 7, 1948, with a specific gravity of 1.290 high, 1.285 low, voltage +2.4, −2.4. Discharged 0745 June 7, 1948, at 300 amperes for 11 minutes. On charge June 7, 1948, off charge 1230 June 9, 1948, with a specific gravity of 1.280, voltage +2.5, −2.5. Charging time 15 hours drawing 2 amperes at finish. Specific gravity check June 14, 1948, 1.290 high, 1.285 low. Installed in jeep June 15, 1948, specific gravity 1.290, temperature 95° F. After installation ran starter, motor and lights till discharge of battery would not turn engine, time 7½ minutes immediately after discharge, specific gravity was 1.240 high, 1.235 low, temperature 95° F., connecting terminals cool, electrolyte was clear. After 5 minutes time period to allow the electrolyte to balance specific gravity 1.225, temperature 95° F. Turned ignition system on and started engine in approximately 3 revolutions generator charge rate indication for 5 minutes 30 amperes value. Stopped engine, ran starter motor and lights again for 3½ minutes, starter motor showed evidence of excessive heating to continue to run down of battery. Started engine and returned jeep 1 mile to parking space. Again ran starter motor for 6 minutes with no signs of battery breakdown. Returned jeep to motor pool for overnight parking. (Note: SMMPF3 assigned jeep.) If the strength of the electrolyte is allowed to remain low for a considerable period, as when the battery is discharged, the lead sulfate which acts as a binder for the lead peroxide will disappear, with accompanying disintegration of the cell. Specific gravity check June 17, 1948, 1.280 high, 1.275 low, temperature 90° F. The charging of this battery was accomplished during normal operation of vehicle. Ran starter motor and lights for 8½ minutes immediately after discharge, specific gravity was 1.230 high, 1.225 low, temperature 101° F. After 5-minute time period to allow the electrolyte to balance, specific gravity was 1.225, temperature 100° F. Connecting terminals cool, electrolyte was clear. Battery in very good condition. Specific check June 21, 1948, 1.275 high, 1.270 low. The charging of this battery was accomplished during normal operation of vehicle.

(*g*) 12VA: New dry charged battery, type 7–B, Surrettee battery, strap date DS12–RH–15 (April 1948). Filled with 1.275 acid, cooling time 7 hours. On charge 2000 June 1, 1948, treated with "Protecto-Charge" June 2, 1948, off line 1300 June 8, 1948, with a specific gravity of 1.285 high, 1.275 low, voltage +2.5. Charging time 40 hours drawing 4 amperes at finish. Adjusted electrolyte several times. Specific check June 9, 1948, 1.285, June 14, 1948, 1.295 high, 1.285 low, June 17, 1948, 1.285 high, 1.275 low. Installed in weapon carrier June 17, 1948, 1 minute starter run test. Specific gravity check June 30, 1948, 1.285, temperature 75° F.

(*h*) 12VB: Condemn battery, type 7–B, Gould battery, no strap date. Double wood separators, negative plates soft and spongy, positive plates soft and weak. On charge 1400 June 2, 1948, treated with "Protecto-Charge" June 2, 1948, off line June 7, 1948 with a specific gravity of 1.285 high, 1.280 low, voltage +2.5, −2.3, drawing 10 amperes at finish. Installed in battery cart June 7, 1948. Specific gravity check June 21, 1948, 1.270 high, 1.250 low, temperature 80 °F.

(*i*) 12VC: Condemn battery, type 6–B, Exide battery, strap date 6–LXWG–15–3R. Wood and glass separators negative plates sandy.

No. 1. Positive plates: 6 small cracks.
No. 2. Positive plates: 4 small cracks.
No. 3. Positive plates: 5 small cracks.
No. 4. Positive plates: 5 small cracks.
No. 5. Positive plates: 5 small cracks.
No. 6. Positive plates: 5 small cracks.

On charge 1300 June 11, 1948, treated with "Protecto-Charge" June 11, 1948, off line June 14, 1948, with a specific gravity of 1.285 high, 1.280 low, temperature 90° F. Charging time 24 hours drawing 5 amperes at finish. Installed in truck-tractor June 17, 1948. Specific gravity 1.290 high, 1.285 low, temperature 85° F.; 1 minute starter run in check. Specific gravity check June 21, 1948, 1.285 high, 1.275 low temperature 65° F, June 30, 1948, 1.295 temperature 80° F. Battery breakdown test July 5, 1948. Specific gravity at start of test 1.280 high, 1.270 low, temperature 70° F. Discharged battery 400 amperes, terminal voltage 2.17 for 5 seconds, after 45 seconds 300 amperes, after 3 minutes 260 amperes, terminal voltage 1.46, battery gassing very good. Stopped test at 6 minutes 15 seconds, drawing 240 amperes and a terminal voltage of 1.4 high, 1.2 low, electrolyte temperature 76° F. After 6 minute waiting time to allow for balancing of electrolyte, specific gravity 1.255 high, 1.240 low, temperature 80° F. During test battery terminals were cool. Started engine with starter motor. Good motor turnover speed, engine started in approximately 5 revolutions. Generator charging rate 30 amperes.

(*j*) 12VD: Condemned battery, type 6–B, Globe battery, no strap date. Hard rubber and fiber glass separators negative.

No. 1. Positive plates: 3 cracks.
No. 2. Positive plates: 4 cracks.
No. 3. Positive plates: 4 cracks.
No. 4. Positive plates: 3 cracks.
No. 5. Positive plates: 4 cracks.
No. 6. Positive plates: 4 cracks.

On charge 1115 June 14, 1948, treated with "Protecto-Charge" June 14, 1948, off line 1300 June 15, 1948, with a specific gravity of 1.280, temperature 92° F, voltage + −2.4, charging time 26 hours drawing 6 amperes at finish. Installed in F–1 semi-trailer June 17, 1948, specific gravity 1.285 high, 1.275 low, temperature 65° F. 1 minute starter run in check. Checked specific gravity June 30, 1948, at 1.270 temperature 80° F.

(*k*) 12VE: Condemned battery in service. Battery was removed from Michigan Crane, battery would not keep a charge. Type 6–B, Exide battery, no strap date. Rubber separators, negative plates sandy, positive plates showed overcharge, little mud on bottom. Inspected and treated June 18, 1948, specific gravity before treatment 1.280 high, 1.270 low, temperature 80° F. No bench charging on this battery, battery had been charged before service test. Battery would lose its charge in approximately 5 days. Specific gravity check June 21, 1948, 1.280 high, 1.270 low, temperature 70° F.

(*l*) 12VF: Condemned battery, type 6–B, Firestone battery, no strap date. Would and glass separators, negative plates sandy, positive plates fair condition. On charge 1.400 June 21, 1948, treated with "Protecto-Charge" June 22, 1948. Off line June 22, 1948, with a specific gravity of 1.285 high, 1.275 low, temperature 80° F., voltage +2.4, −2.5 discharged 15½ minutes. Gravity immediately after discharge 1.240 high, 1.210 low, temperature 105° F. On charge 1.245 June 22, 1948, off line June 28, 1948, with a specific gravity of 1.290 high, 1.280 low, temperature 80° F. Discharged 19½ minutes to terminal voltage of 1.48 immediately after discharge specific gravity 1.250 high, 1.240 low, temperature 90° F. On charge 0930 June 29, 1948, off line 0900 June 30, 1948, with a specific gravity of 1.290 high, 1.280 low, voltage +2.4, −2.4, temperature 80° F. drawing 5 amperes at finish. Stored on shelf for service test.

Specific gravity check at end of discharge is taken to determine temperature, time element to start the balancing of electrolyte, and check for internal temperature rise of the electrolyte.

3. The following revision is recommended on service test project P–893–SC. One new 6-volt battery and one new 12-volt battery to be subject to the following tests.

(*a*) Discharge the battery for 1 hour at 40 amperes for a total of 49 amperes, and recharge at the rate of 10 amperes for 4 hours and 30 minutes, for a total of 45 amperes. Allowing 5 ampere-hours for internal loss and efficiency. Once each week (Friday) completely discharge battery and allow to set over the weekend in a discharged state. (Note: This will promote sulfation.) Time element for each cycle is 5 hours and 30 minutes, or approximately 27 cycles per week. When the capacity of the battery on a complete capacity discharge cycle, at the 40-ampere rate, drops below the ampere-hours equivalent to 40 percent of the ampere-hours rated by the manufacture at the 20-hour rate the full life of the battery is considered complete. By this test a comparison between an untreated battery and a treated battery can be made. A battery tested as such will promote sulfation and express in terms of cycles the life expectancy of "Protecto-Charge" treated batteries.

For the commanding general:

VICTOR L. ANDERSON,
Colonel, USAF, Director of Maintenance.

HEADQUARTERS,
SACRAMENTO AIR MATERIAL AREA,
18 August 1948.

Subject: Status and information of assigned project P–893–SC.
To: Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio.

(Attention: MCMMXC12.)

1. The present 6VA and 6VB batteries have been transferred to the 40-ampere life test and will be referred to in this and future correspondence as 6VA7HR and 6VA7HB. These batteries have been supplemented by two (2) each, type 9–T batteries used in a magnetic inspection machine and these supplemental batteries will be referred to as 6VA and 6VB.

2. Service test and data of the following batteries:

(*a*) 6VA battery was installed in Magnaflux machine, December 1947, new. It showed signs of excessive corrosion on the terminals of external parts, and signs of mild internal sulfation. Due to the high ampere output and low charge rate, this battery is considered ideal for a sulfation service test. This battery is in fair condition now, and if Protecto-Charge will accomplish what is claimed, it should outlast in terms of life cycles, other batteries of this type. Also comparable tests can be made between untreated and treated batteries. Battery treated July 13, 1948, specific gravity of 1.240 high, 1.230 low, open voltage +2.2.—2.2 temperature 75° F. External corrosion is damp, mushy, and bright blue in color, July 26, 1948, battery specific gravity check August 6, 1948, 1.285 high, 1.265 low, open voltage +2.2—2.2, temperature 86° F. External corrosion showed signs of drying.

(*b*) 6VB, same condition as 6VA. (NOTE.—Batteries are in a parallel circuit. Battery was treated July 20, 1948, specific gravity 1.235 low, 1.245 high, open voltage +2.2—2.2, temperature 75° F. Specific-gravity check July 26, 1948, 1.245 low, 1.255 high, temperature 75° F. Specific-gravity check, August 5, 1948, 1.275 low, 1.285 high, temperature 75° F. After treatment, both batteries showed a definite increase in specific gravity.

(*c*) 6VC, specific-gravity check July 2, 1948, 1.275 high, 1.270 low, temperature 85° F. Battery was completely charged by jeep's generator charging system. Specific-gravity check July 23, 1948, 1.00 high, 1.00 low, temperature 75° F. Reason—loose positive cable terminals, generator relay charging rate below 10 amperes. When the jeep was driven 25 miles per hour with lights on, ammeter would show a 5- to 10-ampere discharge. As this jeep is in constant night use, it is obvious why this battery is in a discharged state at this time. Reset relay to proper charging level. No bench recharge battery. Specific-gravity check August 4, 1948, 1.240 high, 1.235 low, temperature 90° F. Jeep's charging system is operating properly.

(*d*) 6VD, specific-gravity check June 27, 1948, 1.285 high, 1.275 low, temperature 70° F. Specific-gravity check July 7, 1948, 1.240 high, 1.230 low, temperature 60° F. Specific-gravity check July 30, 1948, 1.230 high, 1.225 low, temperature 70° F. It is noted this battery is losing by internal local action

and low rate of charge as this crane is only in use approximately 2 hours per 80-hour week.

(*e*) 6VE, specific-gravity check July 8, 1948, 1.260 high, 1.250 low, temperature 70° F. Specific-gravity check July 14, 1948, 1.240 high, 1.230 low, temperature 84° F. Specific-gravity check July 29, 1948, 1.205 high, 1.185 low, temperature 75° F. It is noted the local action on this shelf-stored battery is abnormal.

(*f*) 6VF, specific-gravity check July 6, 1948, 1.295 high, 1.270 low, temperature 81° F., July 7, 1948, capacity discharge cycle. Terminal open voltage at start 6.4. Discharged at 330 amperes, 4.5 volts, for 5 seconds; 300 amperes, 4.7 volts, for 30 seconds; 260 amperes, 4.40 volts, for 4 minutes; connectors hot; 240 amperes, 4.1 volts, for 6 minutes; at end of 6 minutes electrolyte temperature 100° F., specific gravity 1.210, battery gassing good, allowed 15 minutes to balance eletrolyte, specific gravity 1.210 high, 1.180 low, temperature 102° F. Electrolyte clear. Specific-gravity check July 15, 1948, 1.230 low, 1.240 high temperature 75° F. Specific-gravity check July 22, 1948, 1.270 low, 1.280 high, temperature 70° F. Negative-cell water level, low, cause, broken seal, caused by battery hold-down screw too tight. Resealed and watered all cells and replaced battery in jeep. August 5, 1948, water level low in all cells; cause, relay set too high causing excessive boiling within the battery. Generator relay set to proper level. Specific-gravity check August 6, 1948, 1.245 low, 1.270 high, temperature 80° F. For the remainder of this service test, the negative cell will remain low in specific gravity, reason, loss of electrolyte from cracked seal.

(*g*) 12VA, specific-gravity check July 2, 1948, 1.285 high, 1.280 low, temperature 65° F. Specific-gravity check July 6, 1948, 1.00–1.00, temperature 80° F. Driver of truck found ignition switch on (after 3 days' parking) battery was discharged and would not turn over starter, motortruck had to be towed to start engine. After driving 21 miles with 3 stops and starts, specific gravity was checked at 1.030 high, 1.000 low, temperature 80° F. Battery turned starter motor with ease. (NOTE.—No bench charge.) Specific-gravity check July 7, 1948, 1.190 high, 1.180 low, temperature 70° F., truck driven 51 miles. Specific-gravity check July 8, 1948, 1.220 low, 1.225 high, temperature 68° F. Specific-gravity check July 9, 1948, 1.240 high, 1.230 low, temperature 70° F. Specific-gravity check July 19, 1948, 1.280 high, 1.275 low, temperature 80° F. Battery was in very good condition.

(*h*) 12VB, specific-gravity check June 30, 1948, 1.270 high, 1.240 low, temperature 86° F. Specific-gravity check July 9, 1948, 1.260 high, 1.235 low, temperature 80° F. Specific-gravity check July 21, 1948, 1.220 low, 1.240 high, temperature 100° F. Specific-gravity check 1.000 high and low (cause: water added before hydrometer check by service personnel). (NOTE.—Due to the fact two 12-volt batteries are connected in series to produce 24 volts for aircraft starting. In this case, the untreated battery tends to equalize with the treated battery, thus, local action takes place between the two batteries. The second battery is now treated.)

(*i*) 12VC, specific-gravity check July 9, 1948, 1.270 high, 1.260 low, temperature 70° F. Specific-gravity check July 13, 1948, 1.255 high, 1.250 low, temperature 80° F. Specific-gravity check July 22, 1948, 1.240 high, 1.240 low, temperature 75° F. Specific-gravity check July 29, 1948, 1.250 high, 1.235 low, temperature 80° F. Battery in fair condition.

(*j*) 12VD, specific-gravity check July 6, 1948, 1.290 high, 1.280 low, temperature 70° F. Specific-gravity check July 12, 1948, 1.290 high, 1.275 low, temperature 75° F. Specific-gravity check July 22, 1948, 1.280 high, 1.275 low, temperature 75° F. Specific-gravity check July 29, 1948, 1.270 high, 1.255 low, temperature 75° F. Battery water added.

(*k*) 12VE, specific-gravity check July 7, 1948, 1.270 high, 1.260 low, temperature 70° F. Specific-gravity check July 30, 1948, 1.240 high, 1.220 low, temperature 75° F. Driver reported battery would not start engine after 6 days' idle time. Vehicle had to be pushed to start. Specific-gravity check August 2, 1948, 1.220 high, 1.190 low, temperature 90° F. Battery completely failed. Battery removed for inspection. As no other battery was available to install in crane, the 12VE shelf-stored battery was installed to maintain crane in operations. Inspection of failed battery revealed negative plates very sandy and soft. (Note: Plates were sandy at start of service test. Positive plates overcharged and cracked in several places. As noted, this condition was prevalent at the start of the service test. This battery will stay in the shop for high-load capacity tests and high rate of charge tests, for data obtained by this type of cycling will be valuable in determining the physical qualities and characteristics of a battery

additive such as Protecto-Charge. August 5, 1948, high-capacity discharge, 1,100 amperes, 715 volts, for 2 minutes; 800 amperes, 6.1 volts for 3 minutes; 500 amperes, 5.1 volts for 5 minutes; 250 amperes, 3.0 volts for 5 minutes; at this time, No. 1 and 2 cell reversed, internal temperature 143° F., electrolyte dark brown in color, thus the shedding of the lead peroxide material of the positive plates is very evident. Battery excluded from service test. Battery charged to specific gravity of 1.260 low, 1.265 high, and electrolyte drained for replacement in a test battery selected for shelf storage. The failure of this battery would be termed "Mechanical failure."

(*l*) 12VF, specific-gravity check July 8, 1948, 1.265 high, 1.260 low, temperature 70° F. Specific-gravity check July 14, 1948, 1.250 high, 1.235 low, temperature 82° F. Specific-gravity check July 29, 1948, 1.210 high, 1.185 low, temperature 75° F. August 2, 1948, battery on line at 35- to 40-ampere charge rate. Off line at 1400 and installed in crane W–0098361 in place of 12VE.

3. The following batteries have been added to the service test to determine exactly what detriment or aid battery additives have on the life term of batteries: 2 each type 7H 6V battery which will be coded as follows: 6VA7HR and 6VA7HB. These batteries are subjected to the following tests: Discharge the battery for 1 hour at 40 amperes for a total of 40 amperes, and recharge at the rate of 10 amperes for 4 hours and 30 minutes, for a total of 45 amperes, allowing 5 ampere-hours for internal loss, and efficiency. Once each week (Friday) completely discharge to a terminal voltage of 1.2 and allow to set over the weekend in a discharge state. When the capacity of the battery on a complete capacity discharge cycle at the ampere rate, drops below the ampere-hours equivalent to 40 percent of the ampere-hours rated by the manufacturer at the 20-hour rate, the full life of the battery will be considered complete. It was noted after 8 cycles, the batteries needed a longer time on charge to allow for internal loss in efficiency, thus the charging time was increased to 5 hours' time and still using 10 amperes. This test is conducted at room temperature 76° F.

4. The following experiment is being performed in conjunction with assigned service test to determine a standard test procedure for storage-battery additives: (Use standard safety measures).

(*a*) Battery selection:

One each mechanically sound battery which has had long-term wet storage and the visual inspection of the positive and negative plates reveal advanced stages of hard white sulfation and will not hold a normal charge more than 1 hour.

One each mechanically sound battery which has had normal operation, but has been held at a half-charge state until sulfation will not allow the battery to hold a normal charge more than 1 hour.

(*b*) Test apparatus:

(1) Battery breakdown tester with 300-ampere continuous-discharge rheostat, 3 individual 2.50-volt-range voltmeter and ammeter.

(2) Charging equipment for 6 to 30 amperes.

(3) Three hydrometers, one reserved for each cell.

(4) Watch with second hand.

(5) Three thermometers, O° F. to 150° F.

(*c*) Test arrangements:

(1) Connect the battery in series with the charger.

(2) Connect the rheostat across the terminals.

(3) Connect the ammeter in series with the battery and the rheostat.

(4) Connect the charger to the terminals.

(*d*) Pretest arrangement after proper amount of electrolyte has been added.

(1) Fill each cell with water to the proper level.

(2) Give battery an equalizing charge of 5 amperes for at least 8 hours, recording the amperes, and individual cell voltages at regular intervals.

(3) Record open voltage and specific gravity of each cell.

(4) Discharge the battery at 30 amperes and record the voltage of each cell at 30-second intervals until the voltage of the highest cell has reached 1.7 volts.

(5) Discontinue discharge and record recovery of each cell at 30-second intervals. After 20 minutes, take specific gravity of each cell.

(6) Treat positive cell with battery additive, type 1. Treat middle cell with battery additive, type 2. Treat negative cell with battery additive, type 3.

(NOTE.—Most battery additives consist of sodium sulfate Na_2SO_4 or magnesium sulfate $MgSO_4$ and in some cases a catalyst magnesium oxide, such as Protecto-Charge, thus at this activity and for this experiment, type 1 battery additive will consist of 46 percent Na_2SO_4, 54 percent $MgSO_4$, type 2 battery additive will consist of 5 percent Na_2SO_4, 95 percent $MgSO_4$, and type 3 Protecto-Charge, which consists of Na_2SO_4, $MgSO_4$ and MgO. By using three different

type battery additives in each battery, the detrimental or recovery effects on this battery, if any, may be determined.)

(*e*) Test period:

(1) Charge the battery at any rate up to 30 amperes, but maintain an internal temperature below 110° F., recording the time, amperage, and voltage at regular intervals until the hourly readings with the hydrometer indicate a full charge. Record open voltage and hydrometer reading.

(2) Discharge at 300 amperes, recording voltage at end of each 30-second interval until voltage of highest cell reaches 1.7 volts, then continue discharge as long as rate can be held at 300 amperes. Record voltage and temperature at 1-minute intervals.

(3) Continue discharging at 200 amperes as long as possible and record voltage and temperature at 1-minute intervals.

(4) Continue discharging at 100 amperes as long as possible and record voltage and temperature at 1-minute intervals.

(5) Continue discharging at 50 amperes as long as possible and record voltage and temperature at 1-minute intervals.

(6) Discontinue discharge and record voltage recovery at 30-second intervals until top voltage is reached.

(7) Repeat steps 1 to 6 four times.

(8) Allow the completely discharged battery, step 5, to stand overnight and then repeat steps 2 to 6.

(9) Repeat step 8. (NOTE.—Do not charge battery.)

(10) Charge battery as per step 1. After full charge allow battery to overcharge at 15 amperes for 7 days.

(11) Discharge as per steps 2 to 6.

(12) Disassemble battery and observe condition of plates in the three cells.

(13) Repeat steps 1 to 12, until 1 cell fails, and record cycles.

(14) Repeat test until second cell fails, and record cycles.

(15) Repeat test until third cell fails, and record cycles.

5. By using this breakdown test and the 40-ampere life-cycle test, it is believed "standards" may be set up for battery additives.

For the commanding general:

W. A. WILSON, Jr.,
Captain, USAF.
H. H. TELLMAN,
Colonel, USAF, Director of Maintenance.

NOTE.—After a discussion with McClellan Field, it was determined that a number of types of battery additives were used in this test consisting of different mixtures of sodium and magnesium sulfate. Type 111 was one of these. In all cases, battery AD–X2, formerly known as Protecto-Charge, is referred to in these reports as "P. C." Other types of battery additives used are shown in roman numerals.

SERVICE TESTS AND DATA OF PROJECT P–893–SC

1. 6VA shows external corrosion around cell connectors. This corrosion is light blue in color and semidry. Specific gravity check August 23, 1948, 1.285 high, 1.275 low, open voltage 2.2, 2.1, temperature 73° F. At this time, this battery has a specific gravity reading approximately 10 points above the other untreated batteries.

2. 6VB same condition as 6VA. Specific gravity check August 23, 1948, 1.280 high, 1.275 low, open voltage 2.2, 2.2, temperature 73° F.

3. 6VC battery was completely charged by the jeep's charging system. Battery in very good condition, dry and clean externally. Specific gravity check August 13, 1948, 1.270 high, 1.255 low, temperature 100° F., specific gravity check August 23, 1948, 1.280 high, 1.270 low, temperature 98° F.

4. 6VD battery's electrolyte, through internal normal action and normal discharge, had dropped in solution below 1.160 on the hydrometer, thus, a reading of 0 indicates specific gravity of 1.160 or less. This battery maintained a good ampere output of 150 to 200 amperes, with a terminal voltage of 5.6 over a period of 10 days with each start of the engine, which was approximately 5 per day. During this period the specific gravity was 0. On August 30, 1948, battery was removed from power crane for bench charging and inspection. The spring tension in the reverse current relay was set at its maximum, also the generator charge rate is as high as T. O.'s will allow. The onspeed of the engine is not sufficient to allow the charging system to operate properly. August 17, 1948, specific gravity 1.180 high, 1.175 low, temperature 88° F. August 30, 1948, specific gravity 0, temperature 84° F. Battery on bench charge August 31, 1948,

drawing 8 amperes at 2.1 cell voltage. This battery will be charged to full state and reinstalled in power crane.

5. 6VE specific gravity check August 23, 1948, 1.170 high, 0 low, temperature 72° F., August 31 specific gravity 0, temperature 93° F., open voltage 1.98, 1.99, 1.95. The local action on this battery is abnormal.

6. 6VF specific gravity check August 12, 1948, 1.270 high, 1.245 low, temperature 80° F. Specific gravity check August 16, 1.280 high, 1.260 low, temperature 75° F. On August 30 specific gravity was 0–0, temperature 100° F., open voltage negative 1.05, center 1.62, positive 1.12, reason; lights were accidentally left on over the weekend. Battery was in such a discharge state that the relay on the horn would not click. Battery was removed from jeep for internal inspection. Positive and negative plates were rich in color and very clean. Separators showed no signs of active material upon them. Positive plates were deep brown in color with spotted white-grained-appearing sulfation on approximately 5 percent of the plate area. Active material was soft and spongy with no apparent shedding. Negative plates were medium soft and spongy, very light gray in color and showed very little signs of shedding. Electrolyte was clear. Mud deposits in the bottom of the container were approximately one-eighth inch. Mud was very light in color. Battery reassembled and charged at 20-ampere rate for 5 hours. It was noted the internal temperature was between 95° F. to 100° F. battery installed in jeep with a specific gravity of 1.175 high, 1.165 low. Jeep's charging system will continue charge.

7. 12VA: Weapon carrier was in shop for routine 1,000-mile check. Battery was idle for approximately 10 days. Specific gravity check August 24, 1948, 1.290 high, 1.270 low, temperature 67° F. Battery is in very good condition and has a very good recovery rate.

8. 12VB: Battery test cart is in constant day and night use delivering external power requirements for starting of aircraft removed from storage. This type of test cart takes considerable abuse and as a rule are continually renewing their batteries. To date no battery trouble has developed, nor has a bench charge been required. Specific gravity check August 3, 1948, 1.210 high, 1.200 low, temperature 90° F.

9. 12VC: Specific gravity check August 2, 1948, 1.240 high, 1.230 low, temperature 80° F. August 6, 1.240 high, 1.230 low, temperature 80° F. August 16, 1.245 high, 1.235 low, temperature 65° F. August 19, 1.250 high, 1.240 low, temperature 70° F. August 23, 1.250 high, 1.245 low, temperature 67° F. Battery regaining loss value slowly.

10. 12VD: Specific gravity check August 6, 1948, 1.255 high, 1.235 low, temperature 75° F. August 13, 1.270 high, 1.260 low, temperature 70° F. August 19, 1.255 high, 1.250 low, temperature 75° F. August 27, 1.270 high, 1.255 low, temperature 72° F. Since last capacity discharge battery specific gravity has fluctuated considerably. Battery is in very good condition.

11. 12VE: Discontinued from service test.

12. 12VF: Specific gravity check August 5, 1948, 1.235 high, 1.220 low, temperature 76° F., August 17, 1.235 high, 1.210 low, temperature 86° F. August 30, 1.225 high, 1.190 low, temperature 86° F. Vehicle has not been used to any great extent during the past few days. Battery has a very good starter discharge rate and no trouble with starting the engine cold.

13. 6VA7HR: 40-ampere-hour life-cycle test. On the 18th cycle, full charge was average; specific gravity 1.280 high, 1.275 low. Average cell voltage 2.05. After 1 hour discharge specific gravity was 1.240 high, 1.235 low, temperature 86° F. and an average cell voltage of 1.98. At this point the weekend discharge was started after a continual discharge of 40 amperes for 3½ hours, the terminal voltage was 1.79. Next 15 minutes check the negative cell had failed, voltage was 0.82 while positive cell voltage was 1.7. Specific gravity, 0, temperature 99° F. From the 19th cycle to the 34th cycle the average full charge was; specific gravity, 1.280 high, 1.275 low, temperature 84° F., cell voltage 2.04, after the 40 ampere-hour discharge cycles the average state of the battery was: specific gravity 1.240 high, 1.225 low, temperature 88° F. Second weekend discharge failed again after 4 hours and 15 minutes negative cell voltage again had a sharp decline after reaching 1.75. Battery was removed from the life cycle test for internal inspection. Negative cell had a factory defect of one of the positive grids. In one place the grid cross section was enlarged enough to cause local action in that cell. Positive plates were very soft and in spots mushy. Negative plates showed signs of shedding. Separators washed, grid repaired and battery was reassembled.

From the 34th to the 42d cycle average full charge state was: specific gravity, 1.270 high, 1.250 low, temperature 85° F., cell voltage, 2.05. After the 40-ampere-hour-discharge cycles the average state of the battery was: specific

gravity 1.245 high, 1.240 low, temperature 95°F., cell voltage 2.0. Third weekend breakdown; specific gravity 1.250 high, 1.245 low, average cell voltage, 2.06, temperature 75° F. Discharged for 3 hours and 40 minutes to an average cell voltage of 1.7, terminal voltage of 5.1, specific gravity, 0, temperature 97° F. Total ampere-hour output at this time 146.5. Battery in good condition.

14. 6VB7HR: 40-ampere-hour life cycle test. On the 18th cycle full charge average was; specific gravity 1.280 high, 1.270 low, cell voltage 2.05, temperature 85° F. After the 1-hour discharge average state of the battery was; specific gravity 1.255 high, 1.245 low, cell voltage 1.98, temperature 87° F. First week breakdown; specific gravity 1.285 high, 1.280 low, average cell voltage 2.05, temperature 75° F. Discharged 4 hours to an average cell voltage 1.85, terminal voltage 5.55. Specific gravity 0, temperature 96° F. Total ampere-hour output 160. From the 18th to the 42d cycle, full charge average was; specific gravity 1.285 high, 1.280 low, cell voltage 2.04, temperature 85° F. After each 1-hour discharge, average state of the battery was; specific gravity 1.255 high, 1.250 low, cell voltage 2.0, temperature 90° F. Third week breakdown; specific gravity 1.225 high, 1.220 low, average cell voltage 2.0, temperature 80° F. Discharged 3 hours and 4 minutes to an average cell voltage of 1.78, terminal voltage 5.35, specific gravity 0, temperature 98° F. Total ampere-hour output 146.5. This battery has very good capacity and in much better condition than the 6VA7HR new battery. Thus far these two batteries are maintaining a very good average for the 40-ampere-hour life-cycle test.

15. The experiment being formed in conjunction with the assigned service test for the determination of a standard test procedure for storage battery additives has proven very successful thus far. As the following breakdown test will show, only step 7 can be reached without failure of 1 or 2 cells. Protecto-Charge does, under these conditions, maintain a higher output, lower temperature, higher cell voltage, and longer output than the other type additives. Battery tested this far has been a 7H-type battery, that was in very good mechanical condition and which had sulfated out in use.

(*a*) Battery B–33: Battery had a cracked container, cells were removed and installed in new container, 1.270 electrolyte added, cycled twice and treated with; positive cell additive 54 percent $MgSO_4$, 46 percent Na_2SO_4; center cell additive 95 percent $MgSO_4$, 5 percent Na_2SO_4; negative cell "Protecto-Charge." Cycled and charged to a specific gravity of 1.280, 1.280, 1.285 respectively.

Battery was discharged and charged with the following results:

Aug. 12, 1948

Time	+ Cell, type 1		Middle cell, type II		− Cell (Protecto-Charge)		Temperature
	Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
300 amperes discharge:							
1102	1.72	1.285	1.78	1.285	1.76	1.290	78°, 73°, 73°.
1104	1.72		1.76		1.74		
1106	1.68		1.73		1.70		
1107	1.66		1.72		1.69		
1108	1.64		1.69		1.68		
1110	1.60		1.66		1.64		
1112	1.52		1.64		1.62		
1114	1.34		1.60		1.60		
1116	.80		1.58		1.52		
1118	.20		1.49		1.50		
1120	Rev.		1.38		1.43		
1122	Rev.		.81		1.33		
200 amperes discharged:							
1124	Rev.		.62		1.33		
100 amperes discharge:							
1126	.12		.84		1.54		
1128	.20		.80		1.54		
1130	.24		.60		1.61		
1131	.26		.50		1.64		
1132	.25		.42		1.65		
1133	.29		.31		1.64		
1134	.35		.20		1.63		
1135	.38		.12		1.62		
1137	.46		.00		1.56		
50 amperes discharge:							
1138	.08		.24		1.61		
1140	−.02		.26		1.63		
1141	−.04		.27		1.62		
1143	−.04		.28		1.61		
1145		0		1.170		1.140	135°, 125°, 95°.

August 13, 1948.—The direction of the charging current inside a cell is from the positive plate to the negative plate; upon discharge the current is from the terminal of the positive (lead peroxide) plate through the galvanometer to the negative plate terminal, and from the negative plate to the positive plate inside the cell. The positive terminal of a storage battery must be connected to the positive terminal of the charging lines in order that this same terminal will again be positive.

Second discharge on battery was performed as follows:

(1) Removed the connector strap from negative No. 1 to positive No. 2.
(2) Removed the connector strap from negative No. 3 to positive No. 3.
(3) Installed the connector strap from positive No. 1 cell to negative No. 2 cell.
(4) Installed the connector strap from positive No. 2 cell to negative No. 3 cell.

Thus No. 1 cell is now the negative external cell and No. 3 cell the positive external cell.

At this point No. 3 cell (first test No. 1 cell) reversed and the discharge was discontinued. Temperature and specific gravity taken. Electrolyte clear, no visual breakdown of the plates. The battery will be charged to full charge. No. 3 cell (No. 1 first test) inspected, connectors put back to normal position and if cell is still in serviceable condition, washed, drained of electrolyte with additive (type 1) so tests may be continued. Note: At this point type I additive may be termed as a failure as additives for the lead-acid storage battery.

Time	+ Cell (Protecto-Charge)		Middle cell, type II		− Cell, type I		Temperature
	Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
300-ampere discharge:							
1446	1.82	1.290	1.80	1.285	1.80	1.285	93°, 93°, 93°.
1448	1.84		1.82		1.82		
1450	1.82		1.81		1.79		
1451	1.81		1.80		1.78		
1452	1.80		1.79		1.76		
1454	1.79		1.76		1.72		
1456	1.75		1.74		1.68		
1458	1.72		1.71		1.63		
1500	1.70		1.68		1.50		
1502	1.64		1.61		.61		
1504	1.60		1.56		−.20		
1506	1.58		1.50		−.18		
1508		1.205		1.190		1.210	107°, 108°, 110°.

August 20, 1948.—Charged to specific gravity of No. 1 cell 1.280, No. 2 cell 1.285, No. 3 cell 1.300. Removed No. 1 cell for inspection, removed separators and washed cell and container, replaced separators. Positive plates showed rich brown color, negative plates soft and spongy, good condition, reassembled cell, added 1.285 acid. Added battery additive type III. After addition of additive a 300 constant ampere load was imposed on the battery. (Note: Variable resistance was not available.) Test at constant until No. 1 cell failed, constant until No. 2 cell failed. Constant until 30 amperes and 0.76 volt on No. 3 cell.

Time	+ Cell, type III		Middle cell, type II		− Cell (Protecto-Charge)		Temperature
	Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
300-ampere constant discharge:							
1024	1.81	1.230	1.84	1.285	1.85	1.300	80°, 85°, 79°.
1026	1.84		1.87		1.88		
1028	1.82	1.230	1.88	1.275	1.88	1.285	80°, 80°, 80°.
1030	1.82		1.86		1.87		
1034	1.80		1.84		1.86		
1038	1.77	1.210	1.82	1.250	1.85	1.260	84°, 84°, 84°.
1042	1.66		1.78		1.81		
1046	1.54		1.77		1.80		
1050	.44	1.175	1.73	1.215	1.80	1.225	89°, 89°, 88°.
1052	−.20		1.79		1.82		
1054	−.50		1.80		1.82		
1056	−.52	1.165	1.78	1.200	1.81	1.215	96°, 90°, 89°.
1058	−.56	(1)	1.77		1.80		
1100			1.76		1.77		
1104			1.73	1.190	1.75	1.200	90°, 90°.
1108			1.68		1.71		
1112			1.62		1.68		
1114			1.58	1.175	1.66	1.180	93°, 92°.
1116			1.27		1.55		
1117			1.08		1.48		
1118			.90	1.160	1.43	1.170	95°, 94°.
1120			.80		1.40		
1121			.69		1.37		
1122			.56		1.34		
1123			.46		1.33		98°, 95°.
1125			.38		1.32		
1126			.32		1.32		
1127			.18		1.32		
1128			.09		1.33		
1129			.03		1.33		
1130			(1)		1.32		
1132					1.53		97°.
1134					1.30		
1136					1.26		
1138					1.22		98°.
1140					1.18		
1142					1.141		
1144					1.115		
1146					1.05		
1148					1.029		99°.
1150					1.01		
1154					.985		
Open							
1156	1.975	1.000	1.94	0	.97	0	104°, 104°, 104°.
1158					.94		
1200					.92		
1202					.91		
1204					.88		
1206					.90		
1208					.86		
1210					.825		
1212					.80		
1220					.76		105°.

[1] Out at this point.

August 23, 1948.—Battery was left discharged from August 20 to 0950 August 23. Specific gravity at start of breakdown was less than 1.160. Therefore, all readings will be 0.

Battery was discharged to a terminal voltage of 1.44. This was to balance cell No. 1 and No. 2 to equal cell No. 3 to a low discharge state for the total battery.

Battery charged to 20 amperes with a temperature after 3 hours of 79° F., a total of 6½ hours internal temperature was 84° F. Battery will remain at this rate as long as internal temperature of 110° F. is not reached.

Time	+ Cell (Protecto-Charge)		Middle cell, type II		– Cell, type III		Temperatures
	Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
300 ampere constant discharge:							
0956	1.72		1.67		1.56		74°, 74°, 74°.
0957	1.71		1.66		1.54		
0958	1.70		1.65		1.48		
0959	1.68		1.64		1.33		75°, 75°, 74°.
1000	1.67		1.62		.6		
1001	1.66		1.59		.24		
1002	1.62		1.54		.02		
1003	1.60		1.46		–.02		
1004	1.53		1.30		(1)		
1006	1.27		.88				75°, 75°, 75°.
1007	1.17		.77				
1009	1.04		.67				
1011	.89		.55				76°, 79°, 79°.

[1] Out at this point.

August 24, 1948.—20 ampere charge rate, August 23, 1700 temperature, 93° F.; 1900 temperature, 95° F.; 2100 temperature, 95° F.; 2300 temperature, 98° F.; August 24, 0100 temperature, 84° F.; 0300 temperature, 82° F.; 0700 temperature, 80° F.; 0900 temperature, 90° F.; 1030 temperature, 110° F.; specific gravity, 1.300 high, 1.275 low. At the end of the 200-ampere test the carbon pile broke, therefore, only the 50-ampere test could be accomplished.

(*a*) At this point battery additive type III is questionable.

(*b*) Battery on 20-ampere charge rate 1345.

(*c*) 7–H type battery rated at 200 ampere-hours at the 20-hour rate.

(*d*) Charge:

	Hours
Aug. 23, 1948	7
Aug. 24, 1948	10½
Total at 20 ampere rate	17½

(*e*) 17½×20=350 ampere hours input.

(*f*) Discharge:

	Amperes
25 minutes at 300 amperes, total	125
12 minutes at 200 amperes, total	40
50 minutes at 50 amperes, total	41.7
Total amperes output	206.7

Time	+ Cell, type III		Middle cell, type II		− Cell (Protecto-Charge)		Temperature
	Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
300-ampere discharge:							
1042	1.83	1.275	1.85	1.300	1.86	1.310	104°, 104°, 97°.
1044	1.83		1.85		1.85		
1045	1.83		1.84		1.85		
1046	1.82		1.84		1.85		
1047	1.80		1.82		1.84		
1048	1.80	1.260	1.82	1.275	1.83	1.285	104°, 108°, 108°.
1049	1.78		1.81		1.82		
1050	1.76		1.79		1.80		
1051	1.75		1.78		1.79		
1052	1.75	1.250	1.78	1.255	1.79	1.265	106°, 111°, 111°.
1053	1.72		1.76		1.78		
1054	1.71		1.76		1.77		
1055	1.69		1.74		1.76		
1056	1.68	1.225	1.74	1.230	1.76	1.245	110°, 116°, 115°.
1057	1.63		1.72		1.73		
1058	1.58		1.70		1.72		
1059	1.50		1.68		1.70		
1100	1.16	1.210	1.66	1.210	1.69	1.225	114°, 119°, 118°.
1101	.52		1.63		1.66		
1101:30	.40		1.60		1.64		
1102	.28		1.59		1.64		
1102:30	.20		1.56		1.62		
1103	.15	1.190	1.54	1.195	1.60	1.210	122°, 124°, 121°.
Temperature too high, let cool for 1 hour.							
200-ampere discharge:							
1220	1.77	1.170	1.81	1.175	1.82	1.200	111°, 111°, 108°.
1221	1.74		1.80		1.82		
1222	1.69		1.76		1.78		
1223	1.62	1.170	1.73	1.175	1.76	1.190	112°, 114°, 110°.
1224	1.52		1.70		1.74		
1225	1.06		1.67		1.72		
1225:30	.62		1.66		1.71		
1226	.30		1.64		1.65		
1226:30	.22		1.62		1.69		
1227	.12		1.60		1.68		
1228:30	−.02		1.53		1.65		
1229	−.20	1.160	1.48	1.165	1.62	1.180	118°, 117°, 114°.
1230	−.48		1.16		1.68		
50-ampere discharge:							
1240	1.84		1.945		1.98		
1241	1.72		1.86		1.89		
1242	1.64		1.85		1.88		
1244	1.55		1.82		1.87		
1246	1.44		1.84		1.87		
1248	1.21		1.83		1.86		123°, 118°, 113°.
1250	1.22		1.82		1.86		
1252	1.06		1.81		1.85		
1254	.92		1.80		1.83		129°, 118°, 111°.
1256	.84		1.78		1.83		
1258	.78		1.78		1.82		
1300	.74		1.77		1.82		
1302	.71		1.73		1.81		130°, 118°, 111°.
1304	.70		1.72		1.81		
1306	.63		1.71		1.80		
1308	.62		1.70		1.80		
1310	.60		1.64		1.80		
1312	.55		1.62		1.74		131°, 119°, 111°.
1314	.52		1.54		1.74		
1316	.50		1.51		1.73		
1318	.40		1.21		1.72		
1320	.33		1.04		1.71		
1322	.24		.92		1.70		132°, 120°, 111°.
1324	.21		.80		1.64		
1326	.04		.60		1.62		
1328	−.04		.50		1.53		
1330	−.09		.41		1.50		134°, 121°, 113°.

August 25, 1948.—20-ampere charge rate, August 24, 1930, until 0930 August 25, 1930, temperature, 97° F.; 2100, temperature 95° F.; 2300, temperature 90° F.; August 25, 0100, temperature 82° F.; 0300, temperature 70° F.; 0500, temperature 75° F.; 0700, temperature 100° F.

	Hours
(*a*) Charge:	
Aug. 24, 1948	4½
Aug. 25, 1948	9½
Total at 20-ampere rate	14

(*b*) 14×20=280 ampere-hour input.

(*c*) Discharge:	Ampere
21 minutes at 300 amperes, total	105
11 minutes at 200 amperes, total	36.5
9 minutes at 100 amperes, total	14.9
19 minutes at 50 amperes, total	15.8
Total amperes output	172.2

Time	− Cell, type III		Middle cell, type II		− Cell (Protecto-Charge)		Temperature
	Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
300-ampere discharge:							
1245	1.80	1.280	1.79	1.290	1.80	1.300	94°, 95°, 95°.
1251	1.77		1.79		1.80		
1253	1.77		1.77		1.78		
1255	1.74		1.74		1.76		
1257	1.71	1.250	1.72	1.250	1.75	1.260	100°, 104°, 105°.
1259	1.69		1.73		1.77		
1301	1.65		1.68		1.72		
1303	1.58		1.65		1.70		
1305	1.43		1.61		1.66		
1306	1.10	1.215	1.58	1.210	1.65	1.220	106°, 111°, 111°.
1308	.45		1.54		1.62		
1309	.24		1.49		1.58		
1310	.11	1.195	1.44	1.190	1.57	1.210	119°, 116°, 114°.
Temperature too high, 1 hour rest.							
200-ampere discharge:							
1415	1.77	1.175	1.78	1.175	1.79	1.195	110°, 110°, 105°.
1417	1.72		1.74		1.77		
1419	1.62		1.69		1.74		
1421	1.00	1.170	1.63	1.170	1.69	1.185	113°, 112°, 109°.
1423	.30		1.57		1.66		
1424	.05		1.50		1.64		
1425	−.13		1.42		1.61		
1426	−.48		1.06		1.56		
100-ampere discharge:							
1429	.66		1.63		1.71	1.170	125°, 116°, 112°.
1430	.33		1.60		1.71		
1431	.14		1.50		1.69		
1432	.06		1.32		1.67		
1433	.02		1.18		1.66		
1433	−.08		.77		1.63		
1434	−.27		.77		1.60		
1435	−.47		.59		1.55		135°, 122°, 114°.
1436	−.62		.38		1.39		
1437	−.63		.35		1.30		
50-ampere discharge:							
1443	.92		1.70		1.78		140°, 125°, 114°.
1444	.71		1.66		1.77		
1445	.64		1.65		1.76		
1447	.58		1.63		1.76		
1449	.50		1.58		1.75		
1451	.40		1.49		1.74		
1453	.29		1.26		1.71		140°, 126°, 115°.
1455	.22		1.13		1.70		
1457	.05		.87		1.67		
1459	−.08		.69		1.64		
1501	−.18		.61		1.62		
1502	−.34		.48		1.57		
1503	−.45		.40		1.52		
1504	−.49		.38		1.49		140°, 127°, 115°.
Voltage recovery:							
Open: 1508	1.0		1.53		1.81		

August 26, 1948.—20-ampere charge rate 1930 August 25, 1948 until 0930 August 25. 1930 temperature, 98° F.; 2100 temperature, 96° F.; 2300 temperature, 91° F.; August 26, 0100 temperature, 82° F.; 0300 temperature, 72° F.; 0500 temperature, 76° F.; 0700 temperature, 85° F.; 0930 temperature, 98° F.

(*a*) Charge:	*Hours*
Aug. 25, 1948	4½
Aug. 26, 1948	9½
Total at 20-ampere rate	14

(*b*) 14×20=280 ampere-hour input.

(*c*) Discharge:	*Amperes*
22 minutes at 300 amperes, total	110
5 minutes at 200 amperes, total	12. 7
5 minutes at 100 amperes, total	8. 35
6 minutes at 50 amperes, total	5. 00
Total amperes output	136. 05

Time	+ Cell, type III		Middle cell, type II		− Cell (Protecto-Charge)		Temperature
	Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
300-ampere discharge:							
1244	1. 81	1. 295	1. 82	1. 295	1. 82	1. 305	94°, 94°, 94°.
1245	1. 82		1. 82		1. 82		
1247	1. 74		1. 80		1. 81		
1249	1. 74		1. 80		1. 80		
1251	1. 73	1. 265	1. 74	1. 255	1. 74	1. 270	92°, 100°, 101°.
1253	1. 71		1. 72		1. 73		
1255	1. 70		1. 71		1. 72		
1257	1. 62		1. 70		1. 71		
1259	1. 51	1. 225	1. 63	1. 215	1. 70	1. 230	103°, 108°, 108°.
1301	. 52		1. 60		1. 63		
1302	. 33		1. 53		1. 62		
1303	. 21		1. 51		1. 61		
1304	. 04	1. 200	1. 41	1. 195	1. 54	1. 215	100°, 103°, 111°.
1305	−. 01		1. 11		1. 53		
1306	−. 30	1. 190	. 90	1. 185	1. 50	1. 200	124°, 117°, 115°.
Open							
1309	1. 50		1. 90		. 1. 93		
200-ampere discharge:							
1417	1. 74		1. 80		1. 81	1. 180	112°, 110°, 108°.
1418	1. 71		1. 72		1. 73		
1420	1. 44		1. 62		1. 70		
1421	. 71		1. 60		1. 64		
1422	. 00		1. 43		1. 62		118°, 115°, 110°.
100-ampere discharge:							
1424	. 10		1. 33		1. 64		
1427	−. 01		. 93		1. 62		
1428	−. 42		. 70		1. 60		
1429	−. 53		. 52		1. 50		131°, 122°, 114°.
50-ampere discharge:							
1431	−. 34		. 63		1. 43		
1433	−. 43		. 62		1. 43		
1435	−. 54		. 60		1. 42		
1437	−. 64		. 54		1. 42		138°, 128°, 115°.
Open							
1439	. 93		1. 54		1. 81		

August 27, 1948.—20-ampere charge rate 1930 August 26, 1948 until 0930 August 27, 1948. 1930 temperature, 92° F.; 2300 temperature, 87° F.; August 27 0100 temperature, 82° F.; 0300 temperature, 80° F.; 0500 temperature, 92° F.; 0700 temperature, 94° F.; 0930 temperature, 95° F.

(a) Charge:	*Hours*
Aug. 25, 1948	4½
Aug. 26, 1948	9½
Total at 20 ampete rate	14

(*b*) 14 × 30=280 ampere-hour input.

(*c*) Discharge:

	Ampere
21 minutes at 300 amperes, total	105
3 minutes at 200 amperes, total	10
15 minutes at 100 amperes, total	25
15 minutes at 50 amperes, total	12.5
Total amperes output	152.5

Time	+ Cell, type III		Middle cell, type II		− Cell (Protecto-Charge)		Temperature
	Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
300-ampere discharge:							
1420	1.84	1.280	1.86	1.280	1.86	1.300	102°, 104°, 102°.
1421	1.84		1.84		1.86		
1422	1.84		1.84		1.84		
1424	1.82	1.265	1.82	1.255	1.84	1.270	105°, 109°, 109°.
1426	1.78		1.80		1.82		
1428	1.76		1.78		1.80		
1430	1.74		1.76		1.78		
1432	1.68		1.74		1.76		
1434	1.63		1.70		1.74		
1436	1.50	1.215	1.67	1.205	1.70	1.225	112°, 118°, 115°.
1438	.68		1.62		1.68		
1441	.01	1.190	1.30	1.185	1.56	1.200	121°, 125°, 120°.
200-ampere discharge:							
1443	.14		1.00		1.53		
1444	0		.72		1.30		
100-ampere discharge:							
1445	.44		1.04		1.52		
1447	.44		1.08		1.53		
1449	.40		1.00		1.48	1.175	145°, 136°, 125°.
1453	.28		.80		1.32		
1459	−.22		.52		.96		152°, 143°, 130°.
50-ampere discharge:							
1503	.18		.58		1.00		
1505	.16		.57		1.00		
1508	0		.56		.98		
1510	−.06		.56		1.00		160°, 148°, 135°.
1513	−.28		.44		.92		
1515	−.32		.36		.88		160°, 152°, 138°.
Open							
1516.5	.87		1.36		1.54		

August 30, 1948.—1. Battery left in a discharge state over the weekend. Disassembled battery for internal inspection.

Positive or No. 1 cell showed excessive shedding of the negative plates. Positive plates were hard but showed uniform shedding. Grids exposed and approximately 50 percent of the active material dissolved.

Center or No. 2 cell showed normal shedding of the positive plates. These plates were soft with a rich brown color. Spot sulfation but in a soft and sandy condition.

Negative plates were soft and sandy and showed spot shedding and spot sulfation.

Negative or No. 3 cell. This cell was very tight in the container. Both positive and negative plates showed a redeposit of active material causing a binding action upon removal from the container. Positive plates were soft and deep rich brown in color. These plates were in very good condition with an apparent redeposit of the active material on the grids.

Negative plates were soft and sandy spots. These plates were gray in color and in average condition. The redeposit on these plates had formed on the edge of the plate and if continued will cause local action. Battery reassembled and will be charged to full charge so breakdown test may be continued.

At this time battery additive type III may be considered of no value to the lead-acid type battery, for excessive shedding of the plates is evident. Type II has no effect on the battery at this time.

Protecto-Charge cell is still in very good condition and has very good capacity as the breakdown test shows.

2. A comparable test has been set up with two each batteries that had sulfated out in storage. Two each Trojan, type 2H, batteries were received that had been in wet storage since 1944. These batteries will be referred to as "R" and "P."

"R" battery was opened, separators removed and plates washed. Sulfation that had formed on the grid was scraped off, container washed out, new separators installed and battery reassembled. Battery was in a very bad state of sulfation. Battery on charge August 26, 1948 drawing 8 amperes, off charge August 29 drawing 3 amperes with an average cell voltage of 2.4, specific gravity 1.280 high, 1.275 low, temperature 74° F. Battery was stored on shelf for local action check. August 31, 1948, specific gravity 1.275 high, 1.270 low, temperature 82° F.

"P" battery only had electrolyte added with the addition of Protecto-Charge. Battery on charge August 26, 1948 drawing 8 amperes, off charge August 29 drawing 2 amperes, with an average cell voltage of 2.4, specific gravity 1.300 high, 1.290 low, temperature 95° F. Battery was stored on shelf for local action check. August 31 specific gravity 1.300 high, 1.290 low, temperature 82° F.

The above batteries will be subjected to the 300-, 200-, 100-, and 50-ampere breakdown tests to determine if battery additives are helpful in increasing the battery ampere-hour and life. As these batteries are identical as to condition, type, and manufacturer, a very good comparable test between an untreated and a treated battery may be accomplished.

3. It has been observed that this type of battery additive effects the active material of a lead-acid storage battery because of the fact that they alter the crystal growth of the lead sulfate as it is formed. This is recognized at the time of internal inspection of the batteries and observation of glass cells. Sulfation does form but in small spots that are grainy in appearance and very white. It is a definite fact that this type of additive slows up the rate at which the lead sulfate crystals grow, also the way in which they grow, as if small crystals of salt. Upon inspection of the plates, the active material of the positive plates is tight against the grid and when overcharging small bubbles appear on the surface of the active material. It is these bubbles which form at the grid of an untreated battery that is responsible for the shedding of the active material. These bubbles are fine and appear at the surface of the active material of a treated battery, it is this feature which prevents shedding of the active material from the grids. Then by the process of Electro-Phoresis the charged active material is the battery, mud will float on the gas bubbles to the surface of the electrolyte where they fall back through the electrolyte and are attracted by their respective positive or negative plate, thus the rebuilding of the active material is apparent. This phenomenon has been observed in three single cell plexiglass batteries that are under observation and treated with this type battery additive.

From: HQ, SMAMA.
To: CG, AMC, Dayton, Ohio.

201022Z, Sept. 1948,
H. H. Tellman,
Colonel, USAF,
Director of Maintenance.

(SMMPF–9–102)

Request experiments as outlined in letter dated September 9, 1948, MCMMXT31–MLT, be conducted at this command. This in compliance with Pioneers, Inc. Request as of September 16, 1948, whereby they expressed the desire to have subject experiments performed at this base for the purpose of verification of results obtained. Letter from Pioneesr, Inc., has been forwarded your command requesting subject tests to be performed at this activity.

CG, SMAMA.

From: Wright Pat AF Base, Dayton, Ohio.
To: CG, SMAMA.

Unclass.
Airmail.

(Attention AF–901–CSD).

MCMSXE73–9–565–1, Class 19–C. Request immediate action be taken to physically inspect all condemned lead storage batteries, including aircraft. Those batteries found to be free of broken cases, terminals, or other visual defects are to be held in storage pending further instructions from this headquarters. This action is necessary as this headquarters is exploring the possibility of returning such batteries to a serviceable condition through the utilization of new process. Upon completion of this inspection, request this Hqs be advised the total number of such batteries by AF stock number being held in storage.

Copy rec'd from Supply.
Supply Action, 29 Sept. 1948.

LESTER W. LIGHT,
Col. USAF, Chief, Equip. Sec. Auto Br.

HEADQUARTERS,
SACRAMENTO AIR MATERIAL AREA,
McClellan Air Force Base, Calif.

Subject: Status and Information of Assigned Project P–893–SC.
To: Commanding General, Air Material Command, Wright-Patterson Air Force Base, Dayton, Ohio.
(Attention: MCMMXC53)

Battery service test data compiled over the last fifteen (15) day period, is enclosed for your information.

For the Commanding General:

H. H. TELLMAN,
Colonel, USAF,
Director of Maintenance.

1 encl: Ser. Test and Data Report.

SERVICE TEST AND DATA OF PROJECT P–893–SC

1. 6VA: External corrosion is still light blue in color and semidry. Specific gravity check September 1, 1948, 1.280 high, 1.265 low, open cell voltage −2.2, −2.2, temperature 80° F.; September 21, 1948, 1.265 high, 1.255 low, temperature 72° F. Battery charger was left off for two 8-hour operating periods. Battery's specific gravity reading was approximately 10 to 15 points above the other untreated batteries.

2. 6VB: Same condition as 6VA. Specific gravity check September 1, 1938, 1.280 high, 1.265 low, temperature 80° F.; September 21, 1.270 high, 1.260 low, temperature 72° F.

3. 6VC: Battery in very good external condition, dry with no signs of corrosion. Specific gravity check September 20, 1948, 1.210 high, 1.205 low, temperature 72° F. Ran Jeep's starter motor and lights continually for 5 minutes. Starter motor turned engine over very well during this period. After allowing battery to remain idle for 3 minutes to balance the electrolyte, the specific gravity 1.205 high, 1.200 low, temperature 75° F. Battery is in a very good condition, although a little low in specific gravity. This Jeep is used at nighttime with a constant light drain on the battery, the daytime charge will only build about 20 points.

4. 6VD: Battery bench charged to full specific gravity reading of 1.285 high, 1.280 low, charging rate was 8 amperes. Reinstalled in crane September 8, 1948, with a specific gravity of 1.280 high, 1.280 low, temperature 80° F. Specific gravity check September 13, 1948, 1.225 high, 1.225 low, temperature 92° F. The on speed of the generator is not sufficient to allow the charging system to operate properly. It is recommended the design and type of units used on this type of crane be checked for proper operation while the crane is under normal operation.

5. 6VE: Specific gravity check September 21, 1948, 0, 0, 0, temperature 75° F., open voltage +1.47, center, 1.97, −1.44.

6. 6VF: Installed in Jeep September 2, 1948, with a specific gravity of 1.175 high, 1.165 low, temperature 80° F. September 6, 1948, jeep was put in low gear and starter motor used to motorize the vehicle, total time 5 minutes. Starter motor had very good turnover speed. Specific gravity at the end of this test was 1.185 high, 1.180 low, temperature 85° F. Specific gravity check September 8, 1948, 1.225 high, 1.200 low, temperature 76° F.; September 16, 1948, 1.285 high, 1.280 low, temperature 75° F., jeep's charging system charged this battery.

7. 12VA: Specific gravity check September 20, 1948, 1.265 high, 1.260 low, temperature 74° F. Battery was capacity discharged with the following results:

Time	Amperes	Terminal voltage	Positive cell voltage	Negative cell voltage	Temperatures
1325	300	9.8	1.62	1.64	80° F.
1327	280	9.6	1.56	1.62	
1330	260	8.6	1.48	1.52	
1332	210	6.8	1.22	1.34	
1333	180	6.0	1.04	1.24	
1335	160	5.2	0.87	1.00	95°.

Specific gravity at the end was 1.220 high, 1.215 low. A constant load of 300 amperes was imposed for 10 minutes, but had dropped off to 160 amperes indicating a very poor discharge from a full charge rate. This battery should dis-

charge at 300 amperes for 18 to 25 minutes. Battery will be charged to full charge then capacity discharged again. (NOTE.—This was one of the new batteries at the start of the service test.)

8. 12VB: Due to the fact that this test cart is in constant use day and night, the battery needs quite a bit of water. This is the only battery under surveillance that needs abnormal rewatering. September 2, 1948, watered all cells, no readings. September 20, 1948, specific gravity check 1.270 high, 1.260 low, temperature 76° F. Battery in very good condition.

9. 12VC: Specific-gravity check, September 2, 1948, 1.255 high, 1.235 low, temperature 94° F. Battery in very good condition.

10. 12VD: Specific-gravity check, August 31, 1948, 1.265 high, 1.255 low, temperature 76° F.; September 16, 1948, 1.250 high, 1.250 low, temperature 64° F. Due to the fluctuation of this battery in service, the refueler charging system will be checked, also the battery will be inspected internally.

11. 12VE: Discontinued from service test.

12. 12VF: Specific-gravity check September 8, 1948, 1.225 high, 1.185 low, temperature 90° F.; September 13, 1948, 1.205 high, 1.185 low, temperature 91° F. Battery has a very good starter discharge rate and no trouble with starting the engine cold.

13. 6VA7HR: 40-ampere-hour life-cycle test. On the 43d cycle, full charge was 1.290, 1.285 low, temperature 95° F. From the 42d to the 58th cycle the average charge state of the battery was 1.290 high, 1.280 low, temperature 90° F., average cell voltage 2.04. After the 1-hour discharge the average state of the battery was 1.245 high, 1.235 low, temperature 92° F., average cell voltage 201. At this point the weekend discharge was started, after a continual 40-ampere discharge for 1 hour. State of the battery was 1.290 high, 1.285 low, temperature 95° F., average cell voltage 2.04. After 4 hours and 15 minutes the average cell voltage was 1.7, specific gravity 0, temperature 112° F. Total ampere-hour output 156. From the 58th to the 70th cycle the average charge state of the battery was 1.275 high, 1.270 low, temperature 85° F., average cell voltage 2.04. After the 1-hour discharge the average state of the battery was 1.240 high, 1.230 low, temperature 90° F., average cell voltage 2.0. At this point the weekend discharge was started after a continual 40-ampere discharge for 1 hour. State of the battery was 1.160 high, below 1.160, temperature 91° F., average cell voltage 2.05. After 3 hours and 15 minutes the average cell voltage was 1.77. Except the negative cell dropped to 1.20. Specific gravity below 1.160, temperatures 105° F. Total ampere-hour output 130. Thus far this new battery is rated as fair.

14. 6VB7HB: 40-ampere-hour life-cycle test. On the 43d cycle, full charge was 1.290 high, 1.285 low, temperature 94° F. From the 42d to the 58th cycle the average charge state of the battery was 1.285 high, 1.280 low, temperature 90° F., average cell voltage 2.06. After the 1-hour discharge the average state of the battery was 1.255 high, 1.250 low, temperature 93° F., average cell voltage 2.01. At this point the weekend discharge was started, after a continual 40-ampere discharge for 1 hour. State of the battery was 1.290 high, 1.285 low, temperature 95° F., average cell voltage was 2.07. After 5 hours the average cell voltage was 1.7, specific gravity below 1.160, temperature 105° F. Total output 200 ampere-hours. From the 58th to the 70th cycle, the average charge state of the battery was 1.270 high, 1.265 low, temperature 92° F., average cell voltage 2.04. After the 1-hour discharge the average state of the battery was 1.240 high, 1.235 low, temperature 95° F., average cell voltage 1.99. At this point the weekend discharge was started after a continual 40-ampere discharge for 1 hour. State of the battery was 1.190 high, 1.170 low, temperature 105° F., average cell voltage 2.03. After 3 hours and 30 minutes the average cell voltage was 1.74, specific gravity below 1.160, temperature 102° F. Total output 140 ampere-hours. Thus far this battery has maintained a very good average for the 40-ampere-hour life-cycle test.

15. Thus far on the additive breakdown test, Protecto-Charge, now known as AD–X2, is the only additive that will go beyond step 7 as outlined. Battery B–33 was discharged and charged with the following results: Battery was charged to full charge September 3, 1948. Battery was left over the weekend in a charge state; September 6, 1948, center cell was discharged by its internal local action. This cell was put on charge for 36 hours, drawing 5 amperes and full charge was 1.175. It was allowed to remain idle for 24 hours and again internal local action discharged the cell. Cell was removed for internal inspection. The positive plates were soft and rich brown in color with no apparent signs of shedding. Negative plates were very grainy, with the active material separated from the

grid. Negative plates showed a complete breakdown. Twenty-five percent of the active material had shed away from the grid. At this point battery additive type 11 (95 percent $MgSO_4$, 5 percent $NaSO_4$) is considered of no value to the lead-acid type battery. Cell was removed from the battery and a bus bar jumper installed between the positive cell and the negative cell, the test continued with only No. 1 and No. 3 cells. Battery left in a full state of charge September 6 to September 17, 1948, for the purpose of determining the rate of local action on the 2 remaining cells. Battery discharged September 17, 1948, with the following results:

Time	+ Cell, type III		Middle cell		− Cell (Protecto-Charge)		Temperatures
	Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
1038	1.83	1.285			1.86	1.300	70°, 70°.
1039	1.86				1.89		
1040	1.86				1.90		
1042	1.86				1.89		
1044	1.85	1.270			1.89	1.285	71°, 74°.
1046	1.84				1.88		
1049	1.83				1.87		
1051	1.82				1.86		
1053	1.80	1.245			1.85	1.255	75°, 78°.
1055	1.77				1.84		
1057	1.75				1.83		
1059	1.73				1.82		
1101	1.70	1.215			1.81	1.230	78°, 81°.
1103	1.66				1.80		
1105	1.47				1.78		
1109	1.40				1.84		
1112	1.08	1.185			1.85	1.200	82°, 84°.
1114	.80				1.84		
1116	.36				1.83		
1117	.00	1.170			1.83	1.190	86°, 85°.
1120	−.18				1.87		
1121					1.82		
1127					1.76		
1129					1.74		

16. The comparable tests on the two Trojan, type 2H, batteries is as follows:
(*a*) "R" battery, discharged September 3, 1948, with the following results:

Ampere	Time	+ Cell		Middle cell		− Cell		Temperatures
		Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
300	1243	1.60	1.250	1.58	1.260	1.54	1.260	84°, 82°, 82°.
300	1244	1.50		1.52		1.44		
260	1245	1.02		1.38		.20		
140	1246	.74		1.46		−.54		
100	1247	.32	1.235	1.40	1.235	−.40	1.230	91°, 90°, 97°.
90	1248	.12		1.28		−.27		
60	1249	.45		1.28		0		
60	1250	.52		1.06		−.04		
60	1251	.52	1.225	.97	1.235	−.01	1.220	102°, 92°, 101°.
60	1252	.53		.90		.14		
60	1254	.46		.77		.12		
60	1255	.38		.65		.05		
60	1256	.28	1.215	.54	1.220	.02	1.205	108°, 102°, 116°.
60	1257	.25		.47		.06		
60	1258	.24		.42		.01		
55	1259	.23	1.210	.40	1.215	.11	1.205	110°, 116°, 120°.

Battery on charge September 3, 1948, water added. Specific gravity 1.190, 1.220, 1.240, off charge September 9, drawing 3 amperes, average cell voltage −2.4, −2.4, specific gravity 1.295 high, 1.290 low, temperature 75° F. Charging time, 50 hours.

Battery discharged September 10, 1948, with the following results:

Ampere	Time	+ Cell		Middle cell		− Cell		Temperatures
		Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
300	1039	1.65	1.275	1.63	1.280	1.60	1.275	80°, 80°, 80°.
300	1040	1.63		1.60		1.56		
300	1041	1.55	1.265	1.53	1.265	1.46	1.260	85°, 84°, 86°.
300	1042	1.46		1.43		1.24		
200	1043	1.54		1.52		1.18		
200	1044	1.38	1.250	1.38	1.250	−.04	1.235	91°, 91°, 100°.
100	1047	.94		.88		−.16		
90	1048	.60		.58		.20		
60	1049	.42	1.240	.45	1.235	.58	1.230	98°, 100°, 115°.
60	1051	.42		.54		.53		
60	1053	.42		.57		.44		
60	1055	.32	1.230	.46	1.230	.24	1.220	106°, 109°, 120°.
60	1057	.27		.38		.12		
55	1058	.08		.36		.10		
50	1059	.28	1.215	.34	1.215	−.09	1.200	112°, 115°, 123°.

After capacity test negative cell was removed for internal inspection. Negative plates dark gray with white sulfation, plates were very hard. Positive plates, dark brown in color with spot sulfation. Grids were broken in several places. Separators were in very good condition. Negative cell was replaced but not connected to the battery. Thus, only the positive and the center cells are in use. This battery will continue the breakdown test with two cells. Battery left in a full state of charge from September 13, 1948, to September 17, 1948, for the purpose of determining the rate of local action on the two remaining cells. Battery discharged September 17, 1948, with the following results:

Ampere	Time	+ Cell		Middle cell		− Cell		Temperatures
		Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
200	1426	1.80	1.300	1.77	1.290			82°, 84°.
200	1427	1.78		1.76				
200	1429	1.74		1.71				
200	1430	1.71	1.290	1.69	1.275			86°, 88°.
200	1432	1.66		1.66				
200	1433	1.62		1.63				
200	1434	1.55		1.58				
200	1436	1.23	1.275	1.50	1.255			91°, 93°.
105	1437	1.42		1.64				
105	1438	1.19		1.63				
100	1440	.82		1.59				
100	1441	.62	1.260	1.53	1.240			98°, 98°.
100	1442	.50		1.28				
100	1443	.48		1.08				
80	1444	.51		1.03				
80	1445	.65	1.250	1.03	1.240			102°, 101°.
80	1447	.61		.97				
75	1450	.57		.86				
75	1452	.52		.75				
75	1453	.39	1.230	.53	1.220			105°, 104°.
75	1456	.33		.46				
70	1458	.23		.46				
60	1459	.29		.60				
60	1500	.19	1.225	.53	1.205			110°, 111°.
50	1502	.12		.52				
50	1504	.11		.50				

(b) "P" battery discharged September 3, 1948, with the following results:

Ampere	Time	+ Cell		Middle cell		− Cell		Temperatures
		Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
300	1057	1.50	1.285	1.55	1.280	1.54	1.280	80°, 80°, 80°.
300	1058	1.35		1.46		1.44		
300	1059	1.15	1.275	1.34	1.270	1.24	1.260	90°, 87°, 87°.
200	1100.5	.65		1.20		.30		
100	1101	1.10		1.30		.40		
100	1103	1.14		1.12		.20		
100	1104	.92		.70		−.06		
90	1105	.86	1.255	.38	1.245	−.10	1.240	91°, 100°, 110°.
70	1106	1.12		.46		.30		
70	1108	1.04		.38		.40		
70	1109	.95		.34		.48		
65	1110	.90	1.245	.34	1.235	.48	1.230	109°, 112°, 120°.
60	1111	.84		.38		.44		
60	1113	.70		.54		.22		
60	1114	.58		.46		.08		
60	1115	.48	1.235	.40	1.225	−.04	1.215	110°, 115°, 123°.

Battery on charge September 3, 1948, specific gravity, 1.190, 1.215, 1.185, off charge September 9, 1948, drawing 3 amperes, average cell voltage −2.5, −2.5; specific gravity, 1.290 high, 1.280 low; temperature, 74° F.; charging time, 50 hours. Battery discharged September 10, 1948, with the following results:

Ampere	Time	+ Cell		Middle cell		− Cell		Temperatures
		Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
300	0956	1.51	1.290	1.60	1.280	1.54	1.275	76°, 76°, 76°.
300	0957	1.40		1.52		1.48		
300	0958	1.25	1.270	1.46	1.260	1.40	1.250	86°, 84°, 86°.
200	0959	1.28		1.54		1.45		
200	1000	1.14		1.53		1.37		
200	1001	.70	1.255	1.42	1.245	1.02	1.240	95°, 90°, 92°.
100	1002	.99		1.51		.82		
100	1004	.96		1.40		.44		
100	1006	.83	1.240	.94	1.230	.16	1.225	106°, 96°, 105°.
100	1007	.82		.30		.14		
85	1008	.84		.24		.16		
70	1009	1.04	1.235	.44	1.225	.40	1.220	110°, 105°, 112°.
65	1011	.94		.42		.48		
65	1013	.86		.38		.53		
60	1014	.81	1.225	.37	1.210	.55	1.210	115°, 114°, 119°.
60	1016	.74		.38		.56		
60	1017	.66		.40		.54		
60	1018	.58	1.215	.36	1.205	.45	1.200	115°, 113°, 122°.
60	1020	.50		.40		.42		
60	1021	.42		.40		.35		
60	1022	.35	1.210	.46	1.195	.30	1.190	120°, 123°, 126°.
60	1024	.24		.43		.18		
60	1025	.22		.46		.16		
55	1026	.20	1.200	.47	1.190	.14	1.185	122°, 126°, 128°.

Due to the fact that "R" battery's negative cell is no longer in use, the negative cell of this battery will be cut out of service so the comparable test may continue under similar conditions. Battery left in a full state of charge from September 13, 1948, to September 17, 1948, for the purpose of determining the rate of local action of the two cells. Battery discharged September 17, 1948, with the following results:

Ampere	Time	+ Cell		Middle cell		− Cell		Temperatures
		Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
200	1508	1.76	1.300	1.76	1.295			84°, 84°.
200	1509	1.72		1.75				
200	1510	1.70		1.74				
200	1512	1.64	1.290	1.70	1.280			86°, 85°.
200	1515	1.46		1.62				
200	1517	1.12		1.58				
100	1518	1.35		1.70				
100	1520	1.30		1.70				
100	1523	.98	1.260	1.69	1.245			100°, 96°.
100	1525	.68		1.65				
100	1527	.38		1.56				
100	1529	.18		1.36				
100	1532	.11	1.230	1.17	1.230			116°, 105°.
60	1534	.37		1.22				
60	1536	.24		1.19				
60	1538	.16		1.11				
60	1539	.11	1.215	1.02	1.215			125°, 110°.
60	1541	.04		.90				
60	1543	.02	1.210	.83	1.210			130°, 115°.

(*c*) It is noted "P" battery has a higher output at this time and in much better condition than the "R" battery. Thus far "R" battery's negative cell failed.

17. Inasmuch as the next 15-day period will terminate assigned project P–893–SC the following is recommended:

(*a*) The present 6VA, 6VB, 6VC, 6VD, 6VF, 12VA, 12VB, 12VC, 12VD, and 12VF batteries remain under the conditions outlined in basic correspondence for a period of 1 year and once each 30-day period a report of general condition of these batteries forwarded your command.

(*b*) Select 3 each 6-volt batteries and 3 each 12-volt batteries to be subjected to the following:

(1) Remove the battery from dry storage.
(2) Add proper electrolyte for specific battery.
(3) Treat with Protecto-Charge.
(4) Twice charge and discharge battery at the specified battery rate.
(5) Store at room temperature for a period of 1 year, noting condition of battery each 30-day period.
(6) At the end of 1 year open battery and inspect for general condition.
(7) Charge the battery once and allow it to remain idle until a specific gravity of 1.200 is reached, noting the time element and the rate of local action. At this point discharge the battery at 70 percent of its rated capacity until a cell voltage of 1.5 is reached.
(8) Recharge the battery and allow it to remain idle for 3 months. Repeat step 7 until battery is no longer of use. The above will determine if batteries treated with a battery additive could be stored wet.

(*c*) The 40 ampere-hour life cycle test be continued; also, authorization for 2 each 12-volt batteries and 2 each 6-volt batteries be subjected to the same tests.

(*d*) The experiments conducted for the determination of a standard test procedure for storage battery additives be continued until such time that a positive test is determined.

(*e*) The comparable test, between new wet stored batteries that have sulfated out in storage, be continued with the addition of 4 each 6-volt batteries and 4 each 12-volt batteries.

(*f*) Authorize this command to treat all automotive-type batteries in active use with Protecto-Charge. Once every 30 days spot check for general condition and general battery troubles that the layman experiences in the field. Subject 2 each 6-volt batteries and 2 each 12-volt batteries to a 200-ampere load until an average cell voltage of 1.5 is reached, then spot check the batteries for the rate of recovery.

(*g*) War Department Technical Manual TM–9–2857 be revised.

18. Thus far battery additive AD–X2, with the trade name "Protecto-Charge," has proven there is a very definite effect of added salts on the physical properties of lead sulfate, as it is precipitated in the storage cell. This process involves the

addition of a powder mixture, of anhydrous sodium sulfate and a slightly basic, nearly anhydrous, magnesium sulfate with the effect of a catalyst, magnesium oxide, to the water while it is filled with the standard sulfuric acid electrolyte. This mixture must be added to the battery at once, if not the catalyst will go out of solution. The results are quite different from that when equivalent amounts of sodium sulfate and epsom salts are used. The active material remains tight to the grid in a soft condition and there is little shedding of the active material that there is an apparent decrease in the amount of battery mud. The tightness of the active material to the grid results in less gassing on charging. very small bubbles distributed on the surface of the plates, rather than at the location of the grids. This feature is advantageous to the lead-acid battery. The above recommendations are made with this in view.

MCMMXT3/MLt/bls
MCMMXT31 29 September 1948

Subject: Sacramento Air Material Area Teletype No. SMMPF–9–102 Relative to Battery Protecto-Charge Tests.
To: Commanding General, Sacramento Air Material Area, McClellan Air Base, Sacramento, Calif.
(Attn: SMM.)

1. In reply to subject teletype, authority is granted to conduct test as requested It is suggested that a comparison test be conducted using a like number of batteries of the types being tested but without Protecto-Charge treatment. Copies of appropriate battery specifications are being enclosed for use as a guide in accomplishing tests.

2. It is requested that this Headquarters be advised, Attn: MCMMXT31, relative to test conclusions.

By command of General McNarney:

James L. Jackson,
Colonel, USAF, Chief, Maintenance Technical Section, Maintenance Division.

3 Incls.
1—Spec No. AN–B–24
2—Spec No. AN–B–25
3—Spec No. 32587

Headquarters,
Sacramento Air Material Area,
McClellan Air Force Base, Calif.

Subject: Status and Information of Assigned Project P–893–SC.
To: Commanding General, Air Material Command, Wright-Patterson Air Force Base, Dayton, Ohio.
(Attention: MCMMXC53.)

Battery service test data compiled over the last twenty-five (25) day period, is enclosed for your information.

For the commanding general.

H. H. Tellman,
Colonel, USAF, Director of Maintenance.

1 Incl., Ser. Test and Data Report.

Service Test and Data of Project P–893–SC

1. 6VA: External corrosion is still light blue color and semidry, the corrosion area has not increased in size. Specific gravity check September 30, 1948, 1.300 high, 1.285 low, temperature 74° F.; October 11, 1948, 1.265 high, 1.260 low, temperature 72° F.; October 18, 1948, 1.300 high, 1.285 low, temperature 74° F. This battery's specific gravity reading is approximately 15 points above the other untreated batteries, 5 points are caused by the addition of the battery additive.

2. 6VB: Same condition as 6VA, specific gravity check September 30, 1948, 1.290 high, 1.285 low, temperature 74° F.; October 11, 1948, 1.270 high, 1.260 low, temperature 72° F.; October 18, 1948, 1.280 high, 1.275 low, temperature 80° F.

3. 6VC: During the month of September, jeep was in repair shop for overhaul October 11, 1948, specific gravity check +1.230, center 1.220, —1.230, tempera-

cure 65° F. Battery was removed from jeep and subjected to the following: Discharged at 300 amperes, fixed resistor method to 200 amperes in 3½ minutes, cell voltage at this time was +1.52, center 0.02, −1.24, temperature +79° F., center 81° F., −76° F. Positive cell was opened for internal inspection, positive plates were rich brown in color, the PbO_2 (active material) was medium soft and tight to the grid. Negative plates showed some signs of shedding, but by the process to electrophoresis had redeposited in a very spongy state with a medium sandy condition. One negative and one positive plate was removed from the positive cell for inspection and washing. The PbO_2 was in very good condition, soft but very tight to the grid. The grid was passing all the required current the active material could produce. Negative plate was soft and grain spongy on the surface, but washing revealed the Pb was soft, spongy, and very tight to the grid. The grid bars were medium hard and very clean in color. Although the Pb was not as tight to the grid as the PbO_2. Battery was reassembled with the removed positive and negative plates left out, battery installed in jeep. Starter motor turned engine over very well. Jeep's charging system was charging 35 amperes at approximately 2,000 r. p. m. of the engine. This battery is in fair condition.

4. 6VD: Specific gravity check September 28, 1948, 1.230 high, 1.225 low, temperature 65° F. Battery was removed from the crane for internal inspection. Negative plates were dark gray in color, with no signs of shedding, the active material was tight to the grid and in a soft spongy condition. Positive plates were dark brown in color with no apparent shedding. This battery is in very good condition, very little mud in the bottom of the container. Battery was reassembled and reinstalled in crane for continued service. Although this battery has low specific gravity readings, no trouble has been reported. Specific gravity check October 18, 1948, 1.200 high, 1.190 low, temperature 55° F.

5. 6VE: Condition check October 18, 1948, temperature 73° F., open cell voltage +1.56, center 1.94, −1.36. Battery shows no signs of external corrosion.

6. 6VF: Specific gravity check October 12, 1948, was below 1.160, thus only temperature of 65° could be recorded. Negative cell was opened for internal inspection and revealed the following: Negative plates light gray in color, the active material had no apparent signs of shedding and was tight to the grid. Positive plates did show shedding, the active material was rich brown in color, medium soft, resilient, and in firm contact with the grid. Battery reassembled and installed in jeep, starter motor had very good turnover speed.

7. 12VA: Specific gravity check September 28, 1948, 1.270 high, 1.260 low, temperature 65° F. Battery was removed from vehicle for internal inspection of the plates. Negative plates were in very good condition, medium light gray in color, resilient and in firm contact with the grid, with no apparent signs of shedding. Positive plates were soft, rich deep brown in color, and the active material was tight to the grid. No battery mud in the bottom of the container. Battery was reassembled and a fixed resistance of 300 amperes was imposed on the battery and in 15 minutes the lead had dropped to 180 amperes. The discharge was as follows:

Time	Terminal voltage	Specific gravity	Temperature
0830	9.5	1.260	65° F.
0835	10.0	1.250	66° F.
0840	8.75	1.240	70° F.
0845	7.5	1.235	70° F.

Although this battery only has a fair discharge rate it stands up very well in service. The battery was reinstalled in vehicle without bench charging. The starter motor had very good turnover speed. Charging rate of the charging system was 35 amperes.

8. 12VB: Specific-gravity check October 12, 1948, 1.265 high, 1.220 low, temperature 65° F. A fixed load of 375 amperes was imposed that dropped off to 300 amperes in 1 minute, the negative-cell voltage was 1.62, positive-cell voltage 1.00. Due to the fact that these were the high and low cells, they were removed for internal inspection. Positive and negative plates are shedding and a very sandy condition is prevalent. Two separators were missing in the negative cell; these were reinstalled and the battery reassembled for continued use. This battery is in very poor condition but will take and hold a charge.

9. 12VC: No check on this battery since September 2, 1948; no reported trouble.

10. 12VD: Specific-gravity check September 16, 1948, 1.250 high, 1.240 low, temperature 64° F.; September 24, 1948, 1.275 high, 1.250 low, temperature 65° F.; September 29, 1948, 1.280 high, 1.200 low, temperature 70° F. Battery removed for internal inspection. Constant load of 300 amperes was imposed for 1 minute and the positive-cell voltage was 0.08. Battery reinstalled in vehicle for continued use. Starter motor had very good turnover speed.

11. 12VE: Discontinued from service test.

12. 12VF: Specific-gravity check September 22, 1948, 1.225 high, 1.200 low, temperature 70° F.; October 12, 1948, 1.250 high, 1.210 low, temperature 86° F. Battery was removed from vehicle for internal inspection. Imposed a constant load of 300 amperes for one-half minute, No. 5 cell voltage was 1.72, No. 1 and No. 4 cells reversed, one negative and one positive plate was removed from No. 5 cell. Negative plate light gray in color, the active material was resilient and in firm contact with the grid. Positive plate was rich brown in color, soft, and the active material tight to the grid. Battery reassembled and installed in vehicle. Starter motor had very good turnover speed. Specific-gravity checked October 18, 1948, 1.215 high, 1.190 low, temperature 66° F. Battery in fair condition.

13. 6VA7HR: 40-ampere-hour life-cycle test. On the 71st cycle, full charge state was 1.285 high, 1.255 low, temperature 104° F. From the 71st cycle to the 85th cycle the average charge state of the battery was: 1.280 high, 1.270 low, temperature 80° F., cell voltage 2.05. After the 1-hour discharge, the average state of the battery was: specific gravity 1.245 high, 1.230 low, temperature 85° F., cell voltage 1.98. At this point the weekend discharge was started, after a continual 40-ampere discharge for 1 hour. State of the battery was: specific gravity 1.285 high, 1.275 low, temperature 80° F., cell voltage 2.06. After 3 hours and 40 minutes, cell voltage was 1.7, temperature 83° F. Total ampere-hour output 146.6. From the 86th to the 125th cycle the average state of the battery was: specific gravity 1.295 high, 1.290 low, temperature 78° F., cell voltage 2.05. After the 1-hour discharge the average state of the battery was: specific gravity 1.260 high, 1.255 low, temperature 82° F., cell voltage 2.00. At this point the weekend discharge was started. (NOTE.—Two weekend discharges of total ampere-hour output of 136 and 138 included) after a continual 40-ampere discharge for 1 hour. State of the battery was 1.280 high, 1.270 low, temperature 100° F., cell voltage 2.04. After 3 hours and 28 minutes the average cell voltage was 1.7, temperature 95° F. Total ampere-hour output 138.7. Thus far this new battery is fair.

14. 6VB7HB: 40-ampere-hour life-cycle test. On the 71st cycle, full charge state was: Specific gravity 1.285 high, 1.280 low, temperature 79° F. From the 71st to the 85th cycle the average charge state of the battery was: Specific gravity 1.280 high, 1.270 low, temperature 75° F., cell voltage 2.05. After the 1-hour discharge the average state of the battery was: Specific gravity 1.255 high, 1.240 low, temperature 80° F., cell voltage 1.99. At this point the weekend discharge was started, after a continual 40-ampere discharge for 1 hour. State of the battery was: Specific gravity, 1.280 high, 1.270 low, temperature 79° F., cell voltage 2.04. After 3 hours and 58 minutes, cell voltage was 1.72, temperature 82° F. Total ampere-hour output 158.7. From the 86th to the 125th cycle the average state of the battery was: Specific gravity 1.295 high, 1.290 low, temperature 85° F., cell voltage 2.05. After the 1-hour discharge the average state of the battery was: Specific gravity 1.255 high, 1.250 low, temperature 74° F., cell voltage 1.99. At this point the weekend discharge was started (NOTE.—Two weekend discharges of total ampere-hour output of 143.4 and 146.7 included), after a continual 40-ampere discharge for 1 hour. State of the battery was: Specific gravity 1.280 high, 1.275 low, temperature 100° F., cell voltage 2.03. After 3 hours and 58 minutes the average cell voltage was 1.73, temperature 95° F. Total ampere-hour output 158.7. Thus far this battery has maintained a very good average for the 40-ampere-hour life-cycle test.

15. **Additive standard test:** This test as outlined has only been carried to step 7. AD–X2 will go beyond step 7, but as yet additives compounded at this command will break down at step 7. Type 7H battery No. B–33, on charge September 20, 1948, for 50 hours drawing 3 amperes. Full charge, cell voltage +2.5, −2.4, specific gravity +1.275, −1.290, temperature 72° F. Battery was discharged September 23, 1948, with the following results:

Ampere	Time	+Cell, type III		Middle cell		−Cell (Protecto-Charge)		Temperature
		Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
Open	1233	2.10	1.275			2.12	1.290	70°, 70°.
200	1235	1.86				1.89		
200	1236	1.88				1.90		
200	1237	1.88				1.90		
200	1239	1.87	1.275			1.90	1.290	72°, 74°.
200	1241	1.87				1.88		
200	1243	1.86				1.88		
200	1245	1.84				1.87		
200	1247	1.83	1.255			1.86	1.260	76°, 76°.
200	1250	1.81				1.85		
200	1252	1.79				1.83		
200	1254	1.77				1.82		
200	1256	1.75	1.235			1.81	1.240	78°, 80°.
200	1259	1.69				1.79		
200	1301	1.60				1.78		
200	1303	.70				1.76		
100	1305	1.28	1.205			1.82	1.210	82°, 85°.
100	1310	.82				1.82		
100	1313	.53				1.80		
100	1315	.42				1.79		
100	1316	.10				1.79		
100	1317	−.43	1.170			1.79	1.175	96°, 98°.
100	1319					1.76		
100	1321					1.74		
100	1322					1.72		
100	1327					1.61	1.170	87°.
60	1330					1.52		
60	1331					1.52		
60	1333					1.43		
60	1335					1.33		Do.
60	1337					1.20		
60	1338					1.15		
60	1340					1.02		
60	1341					.99		90°.
60	1242					.95		
55	1343					.94		Do.
Total ampere-hour output, 143.8.								

Battery on charge September 23, 1948, for 40 hours drawing 4 amperes. Full charge state was, cell voltage +2.6, −2.5; temperature, 64° F; specific gravity, +1.275, −1.285. Battery was discharged September 28, 1948, with the following results:

Ampere	Time	+Cell, type III		Middle cell		−Cell (Protecto-Charge)		Temperature
		Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
Open	1322	2.09	1.260			2.10	1.275	78°, 78°.
200	1323	1.88				1.89		
200	1325	1.88				1.90		
200	1327	1.88				1.89		
200	1329	1.86				1.88		
200	1331	1.86	1.245			1.88	1.265	81°, 82°.
200	1333	1.85				1.88		
200	1335	1.84				1.86		
200	1337	1.82				1.86		
200	1339	1.80				1.84		
200	1341	1.78	1.205			1.83	1.230	86°, 86°.
200	1343	1.75				1.81		
200	1345	1.71				1.79		
200	1347	1.67				1.78		
200	1349	1.61				1.76		
200	1351	1.18	1.185			1.76	1.200	91°, 91°.
170	1352	.68				1.77		
100	1354	.88				1.82		
100	1356	.85				1.82		
100	1358	.79				1.82		
100	1400	.66				1.81		
100	1401	.19	1.160			1.80	1.190	98°, 93°.
100	1402	.02				1.79		
100	1409	−.08				1.73		
100	1411	−.08				1.68		
100	1413	−.09				1.57		
85	1415	−.10				1.36		
60	1417	−.10	1.160			1.32		118°, 94°.
60	1420	−.08				1.12		
60	1422	−.06				1.02		
50	1424	−.32				1.07		120°, 95°.
Total ampere-hour output, 138.83.								

Battery on charge September 28, 1948, for 40 hours drawing 5 amperes. Full charge state was, cell voltage, +2.6, −2.5; temperature, 82° F.; specific gravity, +1.290, −1.300. Battery stored 5 days for local action check. Battery discharged October 6, 1948, with the following results:

Ampere	Time	+Cell, type III		Middle cell (Protecto-charge)		−Cell		Temperature
		Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
Open	1321	2.12	1.270	2.13	1.290			76°, 76°.
200	1322	1.88		1.90				
200	1323	1.89		1.91				
200	1330	1.86		1.88				
200	1335	1.82	1.235	1.86	1.245			82°, 82°.
200	1340	1.77		1.83				
200	1345	1.67		1.79				
180	1349	.90		1.78				
100	1350	1.30	1.190	1.84	1.195			87°, 88°.
100	1355	.80		1.83				
100	1358	.30		1.82				
100	1359	−.20		1.82				
60	1409	−.39		1.84				
60	1415	−.32		1.80				
60	1420	−.24		1.77				126°, 95°.
60	1425	−.40		1.74				
60	1430	−.44		1.70				
55	1434	−.46		1.56				124°, 95°.
Total ampere-hour output, 123.5.								

16. The comparable tests on the two Trojan type 2–H batteries:

(a) "R" battery on charge September 20, 1948, for 40 hours drawing 5 amperes. Full charge state was, cell voltage, +2.5, −2.5; temperature, 73° F.; specific gravity, +1.290, −1.285. Discharged September 23, 1948, with the following results:

Ampere	Time	+ Cell		Middle cell		− Cell		Temperatures
		Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
Open	1321	2.13	1.285	2.12	1.280			78°, 75°.
200	1322	1.78		1.76				
200	1323	1.76		1.74				
200	1324	1.72		1.72				
200	1326	1.65	1.275	1.67	1.270			80°, 79°.
200	1328	1.40		1.58				
170	1329	.62		1.59				
100	1330	.80		1.67				
100	1332	.40		1.60				
100	1333	.05	1.260	1.47	1.250			92°, 87°.
60	1334	−.10		1.58				
60	1336			1.37				
60	1337			1.37				
60	1338		1.235	.94	1.235			100°, 90°.
50	1339			.72				
40	1340			.64				
Total ampere-hour output 32.6.								

"R" battery on charge September 23, 1948 for 20 hours drawing 5 amperes. Full charge state was: cell voltage +2.4, −2.4, temperature 82° F, specific gravity +1.300, −1.290. Battery allowed to remain over the weekend in a full state of charge to check the local action. Specific gravity check September 28, 1948, +1.295, −1.290, temperature 75°. "R" battery on charge September 28, 1948 drawing 5 amperes, off charge October 1, 1948. Full charge state was: cell voltage +2.3, −2.2, temperature 81° F., specific gravity, +1.295, −1.290. Battery was stored 5 days for local action check. After 5 days, local action had dropped the specific gravity to +1.245, −1.240. Thus, the battery's internal discharge is very high and indicates mechanical trouble. Battery was discharged October 6, 1948 with the following results:

Ampere	Time	+ Cell		Middle cell		− Cell		Temperatures
		Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
Open	1054	2.09	1.245	2.08	1.240			70°, 70°.
200	1055	1.68		1.67				
200	1056	1.48		1.62				
200	1057	1.12		1.56				
100	1058	.50		1.72				
60	1059	−.60		1.76				
60	1100	−.58	1.230	1.68	1.225			80°, 75°.
60	1101	−.56		1.42				
50	1102	−.52	1.225	1.17	1.225			87°, 77°.
Total ampere-hour output, 11.36.								

After the discharge, the cells were removed for internal inspection and revealed the positive plates had cracked completely across the horizontal bars midway up the plates. They were very dark brown in color and the active material very hard with cracked imperfections at each grid intersection. The negative plates were dark gray in color and very hard with surface cracks showing separation at the grid. Battery condemned and excluded from service test. This battery was a typical wet stored battery which had sulfated out in storage. The battery was processed through the shop in accordance with T. M.'s and T. O.'s, but failed to respond under normal battery processing and tests. Thus, with batteries such as this one, an additive of the proper type is advantageous to use as the results of the comparable "P" battery will show.

(*b*) "P" battery on charge September 20, 1948, for 40 hours drawing 5 amperes. Full charge state was: cell voltage +2.5, −2.5, temperature 95° F., specific gravity +1.300, −1.300. Discharged September 23, 1948, with the following results:

Ampere	Time	+ Cell		Middle cell		− Cell		Temperatures
		Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
Open	1345	2.13	1.300	2.12	1.300			75°, 73°.
200	1346	1.73		1.75				
200	1347	1.72		1.78				
200	1348	1.69		1.75				
200	1349	1.67	1.290	1.73	1.285			78°, 76°.
200	1350	1.63		1.71				
200	1352	1.57		1.68				
200	1353	1.49		1.66				
200	1354	1.30		1.60				
200	1355	1.08	1.275	1.58	1.265			87°, 85°.
100	1357	1.41		1.70				
100	1359	1.28		1.68				
100	1400	1.18		1.67				
60	1410	.34	1.225	.64	1.230			98°, 98°.
60	1414	.32		.58				
55	1415	.28		.55				
55	1416	.26		.54				
50	1417	.25	1.220	.52	1.215			103°, 104°.
Total ampere-hour output 55.35.								

"P" battery on charge September 23, 1948, for 20 hours drawing 5 amperes. Full charge state was: cell voltage, +2.5, −2.5; temperature, 81° F.; specific gravity, +1.295, −1.290. Battery allowed to remain over the weekend in a full state of charge to check for local action. Specific gravity check September 28, 1948, + 1.290, −1.285; temperature, 78° F. "P" battery on charge September 28, 1948, off charge October 1, 1948. Full state of charge was: cell voltage, +2.4, −2.5; temperature, 80° F.; specific gravity, +1.300, −1.295. Battery was stored 5 days to check rate of local action. After 5 days the internal discharge had dropped the specific gravity to +1.290, −1.275, temperature 69° F. This battery's rate of local action is normal. Battery was discharged October 6, 1948, with the following results:

Ampere	Time	+ Cell		Middle cell		− Cell		Temperature
		Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
Open	1030	2.12	1.290	2.11	1.275			69°, 69°.
200	1031	1.73		1.76				
200	1032	1.69		1.73				
200	1033	1.65		1.70				
200	1034	1.61	1.260	1.68	1.255			74°, 74°.
200	1035	1.56		1.63				
200	1036	1.52		1.62				
200	1037	1.41		1.56				
200	1038	1.28		1.54				
200	1039	.88	1.245	1.40	1.245			75°, 75°.
100	1040	1.26		1.54				
100	1042	1.12		1.29				
100	1043	.93		.46				
90	1044	.97		.26				
60	1045	1.18	1.230	.28	1.225			93°, 84°.
60	1046	1.26		−.02				
60	1047	1.21		−.08				
55	1048	1.12	1.225	−.26	1.220			95°, 90°.
Total ampere-hour output, 40.6.								

Due to the fact that "R" battery failed, this battery's negative cell will be activated and the battery continued in the service test. In the case of this battery, the battery additive did have a very definite effect on the physical properties of the lead sulfate.

17. Inasmuch as the 120-day service test as outlined in assigned project P–893–SC is completed, it is requested this project number remain open until such a date all recommended service tests, both automotive and aircraft, are completed.

HEADQUARTERS,
SACRAMENTO AIR MATERIAL AREA,
McClellan Air Force Base, Calif.

Subject: Status and Information of Assignment Project P–893–SC.
To: Commanding General, Air Material Command, Wright-Patterson Air Force Base, Dayton, Ohio.
(Attention: MCMMXC53.)

Battery service test data compiled over the last forty (40) day period, is enclosed for your information.

For the Commanding General:

H. H. TELLMAN,
Colonel, USAF, Director of Maintenance.

I Incl., Ser. Test & Data Rep.

SERVICE LIST AND DATA REPORT OF PROJECT P–893–SC

1. 6VA: External corrosion is still light blue in color and semidry, the corrosion area has not increased in size. Specific gravity check November 10, 1948, 1.305 high, 1.295 low; temperature, 72° F.; November 19, 1948, 1.310 high, 1.300 low; temperature, 72° F. The gravity reading on this battery is approximately 17 points above the untreated batteries. The untreated batteries have external corrosion which is light blue in color and very damp.

2. 6VB: Same condition as 6VA. Specific gravity check November 10, 1948, 1.300 all cells; temperature 72° F.; November 19, 1948, 1.305 high, 1.300 low; temperature, 72° F. It is interesting to note the 6VA and 6VB batteries now are above the 1.300 mark in gravity reading which indicates the PbSO4 is converting back to Pb and PbO2, thus the higher gravity readings. The amount of additive added will increase the gravity reading about 5 points.

3. 6VC: Battery has a very good capacity as demonstrated by the low gravity readings that are now prevalent, 1.200 to 1.240. This battery as yet shows no sign of breakdown. November 26, 1948, specific gravity 1.220 high, 1.210 low; temperature, 67° F.

4. 6VD: No field trouble has been reported as of this date, although battery has low gravity readings it still delivers the required imposed load to turn the starter motor over at a very good turnover speed.

October 25, 1948, specific gravity 1.175 high, 1.170 low; temperature, 56° F.

November 2, 1948, specific gravity 1.190 high, 1.185 low; temperature, 58° F.

November 8, 1948, specific gravity 1.195 high, 1.180 low; temperature, 68° F.

November 26, 1948, specific gravity 1.220 high, 1.200 low; temperature, 65° F.

5. 6VE: November 29, 1948, battery removed from shelf storage and negative to center cell strap was removed, thus the negative cell can be charged without affecting the other two cells. Negative cell was placed on charge November 29, 1948, at 1300, drawing 5 amperes. November 30, 1948, time 1300, specific gravity 1.215, charging voltge 2.32, temperature 76° F., drawing 5 amperes. December 1, 1948, time 1500, specific gravity 1.240, charging voltage 2.40, temperature 78° F., drawing 5 amperes. December 2, 1948, time 1300, specific gravity 1.265, charging voltage 2.40, temperature 78° F., drawing 5 amperes. December 3, 1948, time 0930, specific gravity 1.275, charging voltage 2.40, temperature 65° F., drawing 4 amperes.

(*a*) At this time the cell has been in storage for a period of 6 months and it received its charge at a very good rate. The battery will set idle for 3 days for a check of location action, then discharged at 20 amperes.

(*b*) December 6, 1948, open-cell voltage +1.42, center 1.46, negative (note charge of this cell). Specific gravity 1.265, temperature 50° F., open voltage 2.08. This cell shows no sign of internal local action. Battery was discharged with the following results:

[Specific gravity at start 1.265; temperature, 50° F.]

Time	Amperes	Voltage	Time	Amperes	Voltage
1005	Open	2.15	1120	26.0	1.98
1005:30	20	2.1	1210	25.5	1.93
1009	20	2.04	1230	25.0	1.91
1010	21	2.00	1250	25.0	1.90
1011	28	2.00	1310	24.5	1.88
1018	28	2.02	1350	24.0	1.82
1023	27.5	2.02	1410	23.0	1.78
1027	27.5	2.02	1420	22.5	1.72
1040	26	2.02	1425	22.0	1.64
1055	26	2.01	1432	20.0	1.50

Specific gravity at end of test, 1.180; temperature, 62° F.

(*c*) In view of the above results and the condition the battery was in at the start of the service test, lead-acid batteries that have been treated may be stored for a period of 6 months with no detrimental effects. Sulfation in this case has had no effect on the cell as the above charge data revealed the cell did take and hold a charge. The capacity output of this cell is excellent.

(*d*) Negative cell opened for internal inspection, positive plates were deep rich brown in color with the active material soft and tight to the grid, the grid was soft and very clean. Positive grid bar was clean of chip sulfation that forms on the grid bar. The active material in the negative plates was medium gray in color, tight to the grid. Grid and grid bar was very clean and showed no signs of sulfation.

(*e*) The center cell will be activated at the end of the 9-month period to check what effects sulfation has on a treated battery stored for 9 months. Also, at the end of the 12-month period.

(*f*) Batteries normally stored for 90 days then recharged may now be treated and stored for a longer period for sulfation has no effects on a battery in storage. This in itself will save many man-hours that are involved in the transportation of the batteries from supply to maintenance and back to supply.

6. 6VF: Battery installed in this Jeep has had a very violent service test as past records will bear out. At present, battery is in very good condition as to trouble-free service. Specific gravity check: October 28, 1948, 1.250 high, 1.250 low, temperature 72° F.; November 9, 1948, specific gravity, 1.250 high, 1.230 low, temperature 70° F.; November 29, 1948, specific gravity, 1.260 high, 1.245 low, temperature 67° F.

7. 12VA: This battery was new at the start of the service test and has maintained very good service, thus far with low gravity readings. Specific gravity check: November 4, 1948, 1.275 high, 1.270 low, temperature 54° F.; November 29, 1948, 1,260 high, 1.255 low, temperature 56° F.

8. 12VB: This battery is still giving trouble-free service in view of the fact of the original condition of the battery, also it is in constant use in aircraft storage for an external source of energy for starting aircraft engines. Specific gravity check: October 27, 1948, 1.245 high, 1.225 low, temperature 55° F.; November 8, 1948, specific gravity, 1.245 high, 1.220 low, temperature 67° F.; November 17, 1948, specific gravity, 1.235 high, 1.210 low, temperature 60° F.; November 29, 1948, specific gravity, 1.250 high, 1.245 low, temperature 62° F.

9. 12VC: As yet not known battery field trouble has been reported. Battery has maintained very good capacity for starting the engine. Specific gravity check November 25, 1948, 1.260 high, 1.240 low, temperature 73° F.

10. 12VD: No field trouble has been reported on this battery. Battery has very good capacity and will supply very good load values to the starter motor. Specific gravity check: October 15, 1948, 1.275 high, 1.225 low, temperature 60° F.; November 29, 1948, specific gravity, 1.280 high, 1.220 low, temperature 67° F.

11. 12VE: Discontinued from service test.

12. 12VF: Battery in very good condition, no field trouble reported as of this date. Specific gravity check October 25, 1948, 1.205 high, 1.190 low; temperature, 66° F. November 2, 1948, specific gravity 1.220 high, 1.200 low; temperature, 60° F. November 8, 1948, specific gravity, 1.225 high, 1.195

low; temperature, 68° F. November 29, 1948, specific gravity, 1.220 high, 1.195 low; temperature, 67° F.

13. 6VA7HR: Forty ampere-hour life cycle test. From the 125th to the 140th cycle the average charged state of the battery was specific gravity 1.285 high, 1.275 low, temperature 79° F., cell voltage 2.05. After 1 hour discharge the average state of the battery was specific gravity 1.245 high, 1.235 low, temperature 80° F., cell voltage 1.99. At this point the weekend discharge output was 146.8 ampere-hours. From the 140th to the 214th cycle the average state of the battery was specific gravity 1.290 high, 1.280 low, temperature 75° F., cell voltage 2.05. After the 1-hour discharge the average state of the battery was 1.250 high, 1.245 low, temperature 75° F., cell voltage 1.99. At this point the weekend discharge output was 130 ampere-hours. Thus far the battery has maintained a good output considering the temperature involved. This test should be accomplished at 0° F., instead at 75° F. for, the rate of sulfation has doubled approximately 3½ times, bearing in mind the rate of sulfation doubles each 18° F.

14. 6VB7HR: Forty-ampere hour life cycle test. From the 125th to the 140th cycle the average state of the battery was specific gravity 1.270 high, 1.265 low, temperature 74° F., cell voltage 2.07. After 1 hour discharge the average state of the battery was specific gravity 1.250 high, 1.240 low, temperature 78° F., cell voltage 1.99. At this point the weekend discharge output was 165.3 ampere-hours. From the 140th to the 214th cycle the average state of the battery was specific gravity 1.285 high, 1.280 low, temperature 76° F., cell voltage 2.07. After the 1-hour discharge at 40 amperes the average state of the battery was specific gravity 1.255 high, 1.250 low, temperature 78° F., cell voltage 1.99. At this point the weekend discharge was 140 ampere-hours. This battery has maintained a very good capacity output, bearing in mind this was a junk battery that was treated. Reference is made to 6VA7HR battery's comments.

15. Battery additive standard test. Battery type 7–H, No. B–33 was fully charged October 13, 1948, positive cell treated with additive type 3; negative cell treated with AD–X2; positive cell specific gravity 1.275, open voltage 2.10; negative cell specific gravity 1.295, open voltage 2.12, temperature 77° F. Battery was discharged October 13, 1948, and it will be noted the negative cell voltage only dropped to 1.86 and held a temperature of 90° F., while the positive cell dropped in cell voltage to 0.44 with a temperature of 105° F. Discharged results as follows:

Amperes	Time	+ Cell, type III		– Cell, Protecto-Charge		Temperature
		Voltage	Specific gravity	Voltage	Specific gravity	
Open	1320	2.10	1.275	2.12	1.295	78°, 77°.
200	1322	1.91		1.95		
200	1325	1.90		1.90		
200	1330	1.86		1.89		
200	1335	1.84		1.87		
200	1340	1.80		1.84		
200	1345	1.72	1.225	1.81	1.235	85°, 87°.
200	1349	1.62		1.79		
195	1350	1.43		1.79		
180	1352	1.5		1.80		
100	1355	1.57		1.84		
100	1357		1.180		1.195	88°, 90°.
100	1358	.8		1.82		
100	1400	.62		1.84		
100	1410	.44	1.150	1.86	1.175	105°, 90°.

Battery type 7–H, No. B–33 was fully charged to positive cell, specific gravity 1.280, open voltage 2.08, negative cell specific gravity 1.300, open voltage 2.10. The following discharges were carried out on the dates listed without recharging between discharges:

Amperes	Time	+Cell, type III		−Cell, Protecto-Charge		Temperature
		Voltage	Specific gravity	Voltage	Specific gravity	
Oct. 19, 1948:						
	1320	2.08	1.280	2.10	1.300	75°, 75°.
200	1320	1.86		1.88		
200	1323	1.85		1.88		
200	1325	1.86		1.89		
200	1327	1.86		1.88		
200	1330		1.265		1.270	79°, 80°.
200	1332	1.80		1.85		
200	1335	1.79		1.82		
200	1337	1.79		1.81		
200	1340	1.72		1.81		
200	1343	1.71	1.230	1.80	1.240	85°, 80°.
200	1345	1.68		1.78		
100	1350	1.56		1.81		
100	1353		1.195		1.210	85°, 88°.
100	1355	1.20		1.81		
60	1400	.60		1.80		
60	1402	.40		1.82		
40	1410	.34	1.150	1.84	1.175	102°, 90°.
	1000	2.04	1.280	2.04	1.305	65°, 65°.
200	1010	1.84		1.85		
200	1012	1.84		1.85		
200	1015	1.87		1.85		
200	1020	1.88		1.85		
200	1025	1.82		1.86		
200	1030	1.75	1.240	1.82	1.250	70°, 75°.
200	1035	1.65		1.80		
100	1040	1.04		1.85		
60	1045		1.195		1.215	80°, 80°.
60	1045	−.010		1.88		
60	1047	−.032		1.89		
50	1048		1.180		1.200	85°, 80°.
Open	1050	1.90		2.00		
No charge.						
Nov. 15, 1948:						
28	1240	1.85		1.92		68°, 68°.
30	1255	1.84		1.91		
29	1301	1.82		1.90		
28	1309	1.81		1.89		
28	1320	1.78		1.88		
28	1330	1.73		1.85		71°, 71°.
25.5	1339	1.50		1.88		
23.5	1344	1.32		1.88		
20	1410	.84		1.87		
19	1429	.71		1.85		
19	1435	.68		1.82		
18	1445	.64		1.84		
16.5	1530	.46		1.76		
16	1600	.36		1.60		
15	1630	(1)		1.40		
12	1700			1.18		
8	1730			.80		
7.5	1800			.71		
6	1830			.57		
5	1900			.45		
3.5	1930			.34		
2.5	2000			.21		74°.
2	2030			.16		
No charge.						
Nov. 16, 1948:						
Open	1000	1.82		1.83		63°, 63°.
25						
17	1002	.76		.74		
12.5	1005	.55		.58		
8.5	1014	.31		.49		
7	1019	.15		.49		64°, 65°.
7	1021	.12		.50		
6.5	1022			.50		
4	1025			.36		
4	1027			.34		
No charge.						

[1] Off line.

Battery will continue its discharge until a completely dead battery is achieved.

16. The comparable tests on the two Trojan-type 2–H batteries:

(*a*) "R" battery failed, discontinued from service test. (Note: this was an untreated battery comparable to "P" Trojan-type 2–H battery.

(*b*) "P" battery is in very good condition. The following discharges were imposed on the battery. After the discharge of October 19, 1948, the battery was not charged for the discharges that followed:

Ampere	Time	+ Cell		Middle cell		− Cell		Temperatures
		Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
Oct. 13, 1948:								
Open	1220	2.13	1.305	2.12	1.300	2.10	1.285	75°, 75°, 75°.
200	1221	1.75		1.80		1.77		
200	1222	1.74		1.79		1.72		
200	1224	1.67		1.73		1.64		
200	1226	1.64		1.71		1.60		
200	1230	1.22	1.270	1.59	1.250	.36	1.235	90°, 87°, 93°.
100	1232	1.40		1.71		.48		
100	1235	1.22		1.66		.5		
100	1237	.93		1.60		.46		
100	1240	.66		1.37		.20		
65	1242	.67		1.4		.18		
60	1245		1.230		1.220		1.200	105°, 98°, 115°.
60	1247	.6		.62		.41		
55	1248	.55		.5		.47		
55	1250	.51		.37		.5		
45	1258	.49		.34		.46		
40	1300		1.205		1.200		1.175	111°, 113°, 130°.
40	1308	.4		.39		.36		
No charge								
Oct. 19, 1948:								
	1335	2.5	1.295	2.2	1.285	2.00	1.290	72°, 72°, 72°.
200	1345	1.67		1.69		1.67		
200	1347	1.64		1.67		1.65		
200	1350	1.60		1.64		1.60		
200	1355	1.44		1.62		1.45		
200	1357	.61		1.40		.81		
100	1400		1.240		1.240		1.250	95°, 90°, 92°,
100	1402	.13		1.63		.86		
100	1404	.17		1.49		.58		
90	1405		1.220		1.225		1.230	102°, 92°, 102°.
60	1410	.32		.96		.32		
60	1412	.30		.88		.32		
50	1414		1.200		1.210		1.215	122°, 100°, 102°,
No charge								
Oct. 28, 1948:								
	0850	2.11	1.275	2.15	1.275	2.11	1.280	62°, 62°, 62°.
200	0907	1.74		1.78		1.74		
200	0910	1.59		1.66		1.56		
200	0913	1.30		1.58		.90		
100	0915	1.33	1.240	1.66	1.235	−.1	1.235	75°, 75°, 85°.
60	0919	1.08		.9		0		
60	0920	1.14		.6		0		
60	0922	1.12	1.235	.4	1.225	−.5	1.225	85°, 80°, 100°.
No charge								
Nov. 15, 1948:								
	1100		1.200		1.205		1.225	70°, 70°, 71°.
27	1102	1.92		1.93		1.94		
30	1104	1.91		1.92		1.93		
30	1106	1.90		1.92		1.92		
30	1108	1.89		1.92		1.92		
30	1111	1.89	1.200	1.91	1.190	1.92	1.215	72°, 70°, 71°.
25	1115	1.90		1.92		1.92		
25	1120	1.88		1.91		1.91		
23	1125	1.88		1.90		1.90		
23	1129	1.87		1.90		1.88		
22	1147	1.80	1.185	1.85	1.180	1.84	1.185	70°, 70°, 71°.
16	1210	1.60		1.28		1.04		
8.5	1230	1.72		0		[1] 0		
7	1233	1.74						72°, 73°, 73°.
15	1247	1.56						
16	1250	1.50						
15	1252	1.45						
14.5	1254	1.39						
14	1257	1.36						
14	1300	1.30						73°.
13.5	1304	1.25						
13	1306	1.24						

[1] 20-minute time period.

Ampere	Time	+ Cell		Middle cell		− Cell		Temperatures
		Voltage	Specific gravity	Voltage	Specific gravity	Voltage	Specific gravity	
Nov. 15, 1948—Continued								
12.5	1308	1.20						
12	1312	1.15						
11.5	1317	1.08						
11.5	1320	1.06						74°.
10.5	1325	1.03						
10.5	1328	1.00						
10	1332	.98						
10	1337	.94						
7	1410	.85						
6	1437	.76						
4.5	1530	.60						
4	1540	.59						
No charge								
Nov. 16, 1948:								
Open	1000	1.87		2.01		2.03		63°, 63°, 63°.
30	1002	.40		1.38		1.25		
12.5	1006	.21		1.25		.72		
7.5	1010	.38		.98		0		65°, 64°, 64°.
7.5	1013	0		.68				
5	1016			.46				
4	1018			.38				
3	1020			.32				
3	1021			.28				
2.5	1024			.27				
2.5	1027			.25				
No charge[3]								

[3] Battery will continue discharge until a completely dead battery is achieved.

17. Two each new Trojan type 2–H batteries that had sulfated out while in storage have been treated and at present have 3 charges and 2 discharges at the 3 ampere charge rate and 30 ampere discharge rate. These batteries are now on the shelf for storage of 1 year. At the end of 1 year the batteries will be charged only once. This test is for the confirmation in our findings for conclusive proof treated batteries may be stored long periods of time with no detrimental effects.

18. It is requested that this project remain open until such a date recommended service tests are completed. The above recommendation is made in view of the fact our findings have proven there is a very definite effect on the physical properties of lead sulfate, as it is precipitated in a lead acid storage cell, when this additive, known as AD–X2, is added. Reference is made to Service Test Report dated October 1, 1948, paragraph 17, subparagraphs a to g.

HQ AMC WRIGHT PATTERSON AFB,
Dayton, Ohio.

CG SMAMA,
MCMMXC–43–2–311

Inasmuch as no further service testing of "Protecto-Charge" will be accomplished by the maintenance division, request that project P893–SC be considered completed. Batteries used in connection with project should be returned to stock if serviceable or economically reparable, the balance should be released to salvage.

M ACTION
Distr: M, MP ACTION, MPF, M–1, MD.

W. H. MONAY,
Colonel, USAF, Chief, Depot Activities,
Section Maintenance Division.

17 Feb 1949.

HQS, SMAMA,
McClellan Air Force Base, Calif.

COMMANDING GENERAL,
Air Material Command,
Wright-Patterson Air Force Base,
Dayton, Ohio.

(Attn: MCMMXT31.)

SMMPF–6–11. Project P893–SC was cancelled February 23, 1949. No further investigation has been accomplished on this project. Batteries were returned to stock as requested in referenced teletype.

H. H. TELLMAN,
Colonel, USAF, Director of Maintenance.

SMMPF/JPC/JWW/mo
JUNE 2, 1949.

EXHIBIT No. 15

AFFIDAVITS OF USERS OF AD–X2

BAY EQUIPMENT CO.,
Richmond, Calif., March 19, 1951.

PIONEERS, INC.,
2411 Grove Street, Oakland, Calif.
(Attention Mr. J. Ritchie.)

GENTLEMEN: On January 20, 1949, we wrote you as follows concerning your product Battery AD–X2:

"This is to advise that in the past year and a half we have used approximately 200 treatment packages of Battery AD–X2 used in protecting our new batteries and reviving old batteries. Our Superintendent Al Gavillet keeps plenty on hand at all times in order that we may be able to serve our customers' needs as well as our own. We are frank to say that we have never had occasion to use anything equal to your Battery AD–X2."

We have now been using Battery AD–X2 for more than 3 years. Since writing the above, we have adopted your Battery AD–X2 service system in its entirety; treating all new batteries and giving them an equalizing charge prior to installation; treating all mechanically sound batteries that are 6 months old or less in composition cases and 1 year old or less in hard-rubber cases. This program has saved us well over 50 percent on our annual battery cost and has greatly reduced equipment down time. For the first time in our existence we have really learned to appreciate a nonprorated guaranty on our batteries.

Wishing you continued success,
Very truly yours,

RAY D. SMITH,
Owner.

APRIL 15, 1953.

HON. EDWARD J. THYE,
Chairman, Senate Select Committee on Small Business,
Senate Office Building, Washington 25, D. C.

MY DEAR SENATOR: Since giving the above statement to Pioneers, Inc., we have used the product Battery AD–X2 continuously with equal success.

In January of this year, Pioneers, Inc., began marketing new batteries treated with Battery AD–X2 and we have been using these new treated batteries with good results.

Based on the above experience, it goes without saying that we make certain that all of our batteries in new equipment and those obtained from other sources are immediately treated with Battery AD–X2.

BAY EQUIPMENT CO.,
(Signed) RAY D. SMITH, *Owner.*

Subscribed and sworn to before me this 16th day of April 1953.

LUKE T. HALCOMB,
Notary Public.

THE WICHITA TRANSPORTATION CORP., INC.,
Wichita 2, Kans., September 5, 1952.

Mr. KENNETH MYERS,
Battery Headquarters,
2215 East 13th St., Wichita, Kans.

EXPERIENCE REPORT ON BATTERY AD–X2

DEAR MR. MYERS: This report represents 18 months of comparative experience with about one-fourth of our batteries, out of a fleet of over 100 buses, treated with Battery AD–X2. Results are as recorded by our professional battery man.

We find that Battery AD–X2 is a genuine battery lifesaver which far more than repays its cost. We find that it does prevent the harmful sulfation which is universally recognized as a major cause of failure and deterioration in lead-acid batteries. We have adopted the recommended method of treating all new and underaged batteries.

Here are some of the facts upon which our findings are based. A 12-volt battery which had had 6 months of service and became discharged was treated and charged. After 6 months more service this battery was opened and inspected. The plates were like new, no shedding, no grid deterioration, no visible sulfation. This battery was replaced in service and will soon complete 2 full years. An untreated battery of identical make and similar service period was opened at the same time. Shedding and grid deterioration were so great that the battery was junked.

We find the life of original-equipment batteries in this day-and-night city bus service to be about 1 year or 40,000 miles. We treated an original-equipment battery of 6 months' service without taking it from the bus. This battery is now in its 23d month and this bus had traveled approximately 116,000 miles by September 1, 1952. Two treated batteries of 18 months' service were recently opened. There was no shedding; the grids were sound; the batteries are still in service. We also find a savings in that there is less downtime with the AD–X2 treated batteries.

Yours truly,

GORDON HENRY, *Maintenance Manager*

APRIL 9, 1953.

Hon. SINCLAIR WEEKS,
Secretary of Commerce, Department of Commerce,
Washington, D. C.

DEAR MR. SECRETARY: As of this date (April 9, 1953) the undersigned has no reason for altering the above statement which was given to Mr. Myers on September 5, 1952, concerning my experience with Battery AD–X2. We have continued to use the material with gratifying results.

Keep up the good work.

(Signed) GORDON HENRY.

Subscribed and sworn to before me this 9th day of April, 1953.

ELLEN MYERS, *Notary Public.*

My commission expires January 14, 1956, in and for county of Sedgwick, State of Kansas.

CALIFORNIA TRACTOR & EQUIPMENT CORP.,
Emeryville, Calif., March 28, 1951.

PIONEERS, INC.,
2411 Grove Street, Oakland 12, Calif.

GENTLEMEN: The following is a report which you requested on our use of Battery AD–X2.

In 1947 we obtained some war-surplus euclids. They had been stored in the Tropics and we found that the batteries could not be normally charged even though they had never been used. In December 1947 we bought 108 treatment packages of Battery AD–X2, treating the batteries as per directions and charged them. These batteries came to full charge after treatment.

After having this experience we adopted your Battery AD–X2 service system, treating all our mechanically sound batteries and sending our junks in for reprocessing. Your method of handling our battery problems has saved up to 50 percent on our battery costs over the past 3½ years, even though we are in a position to get our batteries at dealer's prices. It has also resulted in reducing

down time on our rented equipment. Your full money-back guaranty is appreciated by us after many years of controversy over battery adjustments on a standard warranty basis.

May your success continue in your rather remarkable endeavor.

Yours truly,

(Signed) FRANK I. GUILFORD,
Manager.

APRIL 14, 1953.

Hon. EDWARD J. THYE,
Chairman, Senate Select Committee on Small Business,
Senate Office Building, Washington, D. C.

MY DEAR SENATOR: I wish to congratulate you on the action of your Committee on Small Business to date on behalf of Pioneers, Inc., of Oakland, Calif. Secretary of Commerce Weeks' recent action with regard to the Director of the National Bureau of Standards was also very gratifying to the undersigned

CALIFORNIA TRACTOR & EQUIPMENT CORP.,
FRANK I. GUILFORD, *Manager.*

Subscribed and sworn to before me this 16th day of April 1953.

MYRTLE T. HOPPING, *Notary Public.*

DINWIDDIE CONSTRUCTION CO.,
San Francisco 4, Calif., March 30, 1951.

PIONEERS, INC.,
Oakland, Calif.
(Attention: Mr. Jess M. Ritchie.)

GENTLEMEN: On October 19, 1948, we wrote you as follows:

"A year ago we first treated all of our batteries with AD–X2, including 17 batteries which had been discarded as junk.

"For the new and serviceable batteries treated, the direct result has been a 70-percent decrease in replacements.

"Of the 17 junked batteries, 14 responded and were put back in service. Of these 14, 8 are still in use and giving satisfactory performance.

"We congratulate you on the success of this product and, needless to say, we now immediately treat all new batteries purchased with AD–X2."

Since writing you the above letter we have adopted the Battery AD–X2 Service System on all of our operations. We purchase your reprocessed batteries rather than new batteries when any replacement batteries are required and are continuing to treat all new batteries with Battery AD–X2 in new equipment purchased by our organization. We are still experiencing approximately the same 70-percent reduction in battery replacement costs as indicated in our letter of October 19, 1948. Furthermore, the down time on our operating equipment has also been greatly reduced.

Very truly yours,

JAMES DINWIDDIE,
Vice President.

APRIL 15, 1953.

Hon. EDWARD J. THYE,
Chairman, Senate Select Committee on Small Business,
Senate Office Building, Washington 25, D. C.

MY DEAR SENATOR: Since giving the above statement to Pioneers, Inc., we have used the product Battery AD–X2 continuously with equal success.

In January of this year, Pioneers, Inc., began marketing new batteries treated with Battery AD–X2 and we have been using these new treated batteries with good results.

Because of the above experience, we make certain that all of our batteries in new equipment and those obtained from other sources are immediately treated with Battery AD–X2.

DINWIDDIE CONSTRUCTION CO.,
JAMES DINWIDDIE, *Vice President.*

Subscribed and sworn to before me this 17th day of April 1953.

BLANCHE E. BOEHMER,
Notary Public.

My commission expires October 26, 1956.

CONNOLLY-PACIFIC CO.,
Long Beach 2, Calif., December 16, 1952.

TERRY & CO.,
Maywood, Calif.
(Attention: A. J. "Al" Terry.)

GENTLEMEN: Pursuant to your request, we are happy to provide you with a report of our experience over a period of approximately 5 years during which time we have used Battery AD–X2.

We operate 5 tugs in Long Beach Harbor and in 1947 treated the batteries installed in these tugs with Battery AD–X2. At the time, we considered these batteries on the verge of failure and fully expected that we would have to replace them. Greatly to our surprise and satisfaction we found that after treatment with Battery AD–X2 they would accept a full charge and deliver full capacity. Although some have been replaced, others are still in service.

It was in view of this splendid performance that we called you in regard to a 56-cell, 110-volt mine locomotive battery which we were using on a tunnel job at the San Gabriel Dam. The maximum gravity reading we could get on this battery was 1.220, and it would deliver but a half-day's work between charges. After treatment the battery took a full charge and was able to put out better than 3 day's work between charges. Without the benefit of Battery AD–X2 we were resigned to expending $3,500 for a new battery. The Battery AD–X2 cost $250; we saved $3,250.

Additionally, we have treated batteries in our other equipment of various types with equally as good results. Hence, we unhesitatingly recommend the use of Battery AD–X2 to all who are interested in better battery performance and lower replacement costs.

Very truly yours,

(Signed) J. L. CONNOLLY,
Vice President.

APRIL 9, 1953.

Hon. SINCLAIR WEEKS,
Secretary of Commerce, Department of Commerce,
Washington 25, D. C.

DEAR MR. SECRETARY: Since giving the above to Mr. A. J. "Al" Terry on December 16, 1952, we have continued the use of Battery AD–X2 in our lead-acid storage batteries with the same satisfactory results.

J. L. CONNOLLY,
Vice President.

Subscribed and sworn to before me this 13th day of April 1953.

A. W. SANDERS,
Notary Public.

My commission expires November 13, 1956.

SEPTEMBER 19, 1949.

Dr. E. U. CONDON,
Director, National Bureau of Standards,
Washington 25, D. C.

DEAR SIR: The following statements on Battery AD–X2 as manufactured by Pioneers, Inc., 2411 Grove Street, Oakland 12, Calif., are based on actual experience in the field and on shop tests made by myself.

Over 2 years ago I was approached by Mr. Jess M. Ritchie of Pioneers, Inc., concerning the use of Battery AD–X2. I was familiar with the information contained in Letter Circular 302 as published by the National Bureau of Standards, concerning battery dopes as well as a similar pamphlet published by the National Better Business Bureau. In view of these publications, I was reluctant to try the material. However, I did try it and have since used over 3,000 treatments of Battery AD–X2 in the salvage of batteries returned from overseas installations. These batteries were mechanically sound, but badly sulfated and beyond the point of practical economical recovery without the use of Battery AD–X2.

I have found that badly sulfated batteries which are mechanically sound can be treated with Battery AD–X2 and charged to full capacity without the danger of changing the grid in the positive plate to active material or shedding the active material from the negative plate through gassing in large bubbles between the grid and the active material, as badly sulfated batteries normally do.

I have charged hundreds of sulfated batteries which would normally have been junked by treating them with Battery AD–X2. Many of these batteries are now in their second year of service. To satisfy myself, charging was frequently attempted prior to treatment with little or no results. After treatment with Battery AD–X2 all of these batteries came to full charge. To cite a specific instance along these lines, a battery was left on the charging line for 17 days at approximately 6 amperes, with no results. The battery was then treated with Battery AD–X2 and came to full charge by the time 150 percent of its ampere-hour capacity had been applied at the same 6-ampere rate.

I do not know of any instance where mechanically sound, sulfated batteries have failed to accept full charge after treating with Battery AD–X2. My 28 years of experience in building, repairing, and maintaining batteries qualifies me to state that Battery AD–X2 should definitely be listed as an exception to the rule in such publications as Letter Circular 302 by the National Bureau of Standards.

At the present time I am battery shop foreman at Benicia Arsenal, Benicia, Calif. At the request of Pioneers, Inc., I make these statements as a private citizen and not as a Government employee.

I have no connections with Pioneers, Inc., whatsoever.

(Signed) EMERSON E. BLUM.

Subscribed and sworn to before me this 19th day of September 1949.

HENRY E. WALLACE,
Notary Public.

My commission expires January 2, 1953.

APRIL 14, 1953.

Hon. EDWARD J. THYE,
Chairman, Senate Select Committee on Small Business,
Senate Office Building, Washington 25, D. C.

MY DEAR SENATOR: First allow me as a citizen of the United States to compliment you and your Committee on Small Business on the job done to date in establishing facts concerning Battery AD–X2.

When you have used a product for 2 years and have witnessed beneficial results from it for 5 years, while on the other hand the National Bureau of Standards publishes pamphlets and letters to the effect that the material is worthless, one can't help but doubt the whole bureaucratic structure of his Government.

As outlined in the above affidavit to Dr. E. U. Condon, made on September 19, 1949, the results of the use of Battery AD–X2 are very beneficial. We salvaged through treatment approximately 2,500 batteries which normally would have been junked. Then, in 1949, we received orders from the Chief of Ordnance to discontinue the use of the product and to test the material according to instructions issued by the Office of the Chief of Ordnance. Briefly, these orders, which involved a major portion of the batteries to be tested, were to take batteries from salvage which would normally have been given a prolonged desulfating overcharge, in accordance with salvage procedure, give the batteries another prolonged desulfating overcharge, to make sure that they would not take a charge, then treat them with Battery AD–X2. This was done and all these batteries took a full charge after treatment with the product. These long overcharges normally peroxide the grids out of the positive plates of a battery, unless the battery responds and takes a normal charge.

Despite the fact that this test procedure was apparently written by people who knew very little about lead-acid storage batteries, the test results were definitely favorable to Battery AD–X2, even though the procedure used would normally have been expected to destroy the mechanical soundness of the batteries prior to treatment.

After the tests were completed, we at the battery shop were instructed not to discuss with Pioneers, Inc., or any third parties the results of the tests or the use of the product. The order from the Chief of Ordnance to discontinue the use of the product was never rescinded, with the result that from 1949 to the present time we have junked out well over $100,000 worth of batteries which could have been salvaged had we been permitted to use the product. Furthermore, we are losing batteries every day that could be salvaged if Battery AD–X2 was available to us.

As an example of the foregoing, I would like to cite the following case: In the fall of 1952, we received 100 12-volt truck and bus batteries. These batteries were past strap date and could not be charged although they had never been used. With Battery AD–X2, every one of those batteries could have been

charged, and based on our previous experience with the product, would have been expected to give from 1 to 3 years' service. Instead, the batteries were junked out.

In closing I might mention that we still occasionally find batteries in service that were taken from salvage in 1949 and treated with Battery AD–X2.

EMERSON BLUM.

Subscribed and sworn to before me this 16 day of April 1953.

FRANCES L. ESTEY,
Notary Public.

SEPTEMBER 27, 1949.

Dr. E. U. CONDON,
Director, National Bureau of Standards,
Washington, 25, D. C.

DEAR SIR: I am a licensed marine engineer; I have been port engineer for United States Army, Water Division, Transportation Corps, Fort Mason, Calif., since January 1944. Prior to going to sea, I was maintenance engineer for Whitney Bros., San Francisco, Calif. In the past 20 years I have maintained, operated, and repaired all types of steam, diesel, gasoline, and electric motors and engines, both stationary and marine types. The smaller type engines being started by batteries and in marine equipment we have banks of batteries of 120-volt direct current for emergency use in advent of generator failure. Therefore, I have had considerable battery experience. During that period of time I have come in contact with all types of so-called battery aids. I agree 100 percent with data in letter circular 302 published by your Bureau regarding battery compounds and solutions.

That is, I did agree with your letter circular 302 until I thoroughly tested Battery AD–X2 manufactured by Pioneers, Inc., 2411 Grove Street, Oakland 12, Calif. It is my belief that letter circular 302 is definitely unfair and should not apply to Pioneers, Inc. additive Battery AD–X2. The following is my experience with Battery AD–X2. We maintain a large battery shop where batteries are serviced, repaired, charged, and then installed in vessels. We first experimented with a bank of fourteen 8-volt batteries which were turned over to their manufacturer who for 48 hours attempted to charge 2 of the 14 batteries. The batteries were then opened by the manufacturer and visually inspected. They were sulfated to a point where the manufacturer condemned the entire 14 batteries and recommended replacement. The batteries were then treated with Battery AD–X2, brought to full charge as accepted by the Army inspector. This was done in April 1949 and the batteries are still giving satisfactory service.

We next experimented on batteries that were aboard vessels that had been towed back from overseas for complete overhauling, drydocking and renewal of A. B. S. and Coast Guard certificates. Most vessels are equipped with heavy duty marine type batteries of 208 to 370 ampere-hour capacity and cost from $180 to $400 each. To replace a complete set of batteries run from $3,000 to $5,000. In most cases these batteries have had little or no maintenance for over a year. After servicing the batteries with AD–X2 and cycling them, the results were amazing even to the most skeptical. We took specific gravity readings before and after using AD–X2 and in most all cases the readings after servicing with AD–X2 were or were within a few points of manufacturers specifications.

We have used over 2,000 treatments of Battery AD–X2 in our batteries which were mechanically sound, but badly sulfated and in all cases the results were truly amazing. It is my belief, based on the above tests, that a sound, reliable and guaranteed battery additive has been manufactured by Pioneers, Inc.

I have no connections with Pioneers, Inc. I make these statements as a civilian and not as a Government employee. It is being done of my own free will and at the request of Pioneers, Inc.

(Signed) E. G. CUNNINGHAM,
San Francisco, Calif.

Subscribed and sworn to before me this 27th day of September 1949.

HENRY E. WALLACE,
Notary Public.

My commission expires January 2, 1953.

APRIL 16, 1953.

Hon. EDWARD J. THYE,
Chairman, Senate Select Committee on Small Business,
Senate Office Building, Washington 25, D. C.

MY DEAR SENATOR: Since making the above statement to Dr. E. U. Condon in September 1949, I have had no reason to change my opinion on the product, Battery AD–X2. In fact I have noted the following additional operational benefits to be derived with the use of Battery AD–X2: It reduces charging time, batteries use less water, excessive gassing decreased, thus reducing corrosion on terminals, straps, jumpers, and lugs.

Following are some additional pertinent facts on the subject matter:

The original order for Battery AD–X2 covered 7 cases or 2,100 treatment packages. Approximately 2½ cases of this quantity were used in sulfated but mechanically sound batteries, the material being applied to the batteries by organizations such as the Bethlehem Steel Co., Alameda, Calif., and Height & Struck, of San Francisco, under contracts for overhaul and repair of boats. According to the reports of Army inspectors on the job, the batteries on these vessels were mechanically sound but badly sulfated and could not be charged. However, when Battery AD–X2 was added, the batteries came to full charge.

The balance of approximately 4½ cases were used in 158 marine batteries in the early part of 1949 in active craft which I have periodically inspected since that time. These batteries at time of treatment were from 3½ to 4 years old. At time of treatment, the 158 marine batteries had the following life expectancy:

Approximate percentage:	*Life expectancy*
27	None.
21.5	6 months.
34	12 months.
17.5	18 months.
0	Beyond 18 months.

The foregoing life-expectancy figures are based on data given in the Storage Battery Technical Service Manual published by the Association of American Battery Manufacturers as well as tests made on the batteries.

A check made on these batteries in March 1951 disclosed that all of them were in operation at that time. A similar check in September 1952 revealed that approximately 72 percent of these batteries were in service or stored in a serviceable condition. At no time has there been any indication of failure in these batteries due to sulfation.

Between March 1951 and September 1952, approximately 28 percent of these batteries were lost due to operational failure of vessels in which they were installed.

As an example of the savings to be realized by the United States Government by the use of the product, the batteries on the vessel *FS–170* are cited. These batteries would not take a charge and it would have cost the Government between 3 and 4 thousand dollars to replace them. They were treated with Battery AD–X2 at a total cost of $485 to the Government. After treatment the batteries took a full charge and were inspected and passed by two United States Army inspectors.

My experience has convinced me that all mechanically sound lead-acid batteries should be treated with Battery AD–X2 as a sulfation preventative. This would result in a tremendous saving to the United States Government. This is particularly true of marine batteries which are large and expensive and sulfate out under the very best of operating conditions. This problem is very acute in batteries stored in inactive vessels. In fact, at the present time we have between 30 and 40 thousand dollars worth of batteries that are badly in need of treatment.

I have brought the foregoing to the attention of higher authority and have recommended that all mechanically sound batteries be treated with Battery AD–X2. However, the product has not been adopted at this installation as it is a nonstandard item, i. e. not in our T. C. Catalog.

E. G. CUNNINGHAM.

SAN FRANCISCO 22, CALIF.

Subscribed and sworn to before me this 17th day of April 1953.

HENRY E. WALLACE, *Notary Public.*

My commission expires January 2, 1957.

SEPTEMBER 22, 1949.

Dr. E. U. CONDON,
Director, National Bureau of Standards,
Washington 25, D. C.

DEAR SIR: I, Dallas Brown, of 4020 Norton Avenue, Oakland, Calif., a full partner in Auto Battery & Tire Co., 2829 Broadway, Oakland 12, Calif., make the following statements at the request of Pioneers, Inc., manufacturers of Battery AD–X2.

Since February 1949 I have used over 1,000 treatment packages of Battery AD–X2 for treating new batteries as a sulfation preventative and in restoring sulfated plates in our battery-repair program. By the use of Battery AD–X2 we have eliminated sulfation as a factor in our choice of plates for repairing batteries and as a factor in charging mechanically sound sulfated batteries. I have found that, regardless of the degree of sulfation, a mechanically sound battery can be brought to full charge by the application of Battery AD–X2.

It is not uncommon to have customers bring mechanically sound sulfated batteries to our shop for service after they have attempted to charge them without success. After treatment with Battery AD–X2 these batteries have invariably accepted a full charge, resulting in a very substantial saving for the customer.

I have determined by observation of batteries on the charging rack and by field check with our customers, that batteries treated with Battery AD–X2 use less water than an untreated battery under the same charging or operating conditions; also, that treated batteries have more material available for charge and discharge. As a specific example of this particular point, I cite 12 badly sulfated cells in glass containers which we had in our shop. As an experiment, we treated every other cell with Battery AD–X2 or six cells in all. The 12 cells were placed in series on our charging rack and charged at the 5-ampere rate. The cells treated with Battery AD–X2 were at full charge when 150 percent of their ampere-hour capacity had been applied. The untreated cells did not come to full charge until 500 percent of their ampere-hour capacity had been applied.

I am familiar with Letter Circular 302 published by the National Bureau of Standards and the pamphlet, Battery Compounds and Solutions published by the National Better Business Bureau. Such publications, without making a definite exception of Battery AD–X2 as manufactured by Pioneers, Inc., are unfair to the potential users of Battery AD–X2 and Pioneers, Inc., the manufacturer.

Recently we received a circular from the company that supply us with new batteries. The circular highlighted the publications under discussion, even though the manufacturer is a local concern and is well aware of the merits of Battery AD–X2.

It is my opinion that Letter Circular 302 and the pamphlet, Battery Compounds and Solutions, are of benefit to the public, as there is seldom a week goes by that I do not hear a complaint from someone being "taken in" by a battery "dope." I am well aware of the uselessness and harmful effect of such solutions as are covered in Letter Circular 302. However, as I previously stated, to continue such publications without exception to Battery AD–X2 is unjust and unfair to all concerned.

Prior to my present partnership, I was connected for 8 years with Eb Wells in auto parts and accessories business.

I have no financial connection with Pioneers, Inc.

DALLAS BROWN.

Subscribed and sworn to before me this 22d day of September 1949.

HENRY E. WALLACE,
Notary Public.

My commission expires January 2, 1953.

APRIL 14, 1953.

Hon. EDWARD J. THYE,
Chairman, Senate Select Committee on Small Business,
Senate Office Building, Washington 25, D. C.

MY DEAR SENATOR: Since making the above statement to Dr. E. U. Condon in September of 1949, I have had no reason to change my opinion of the product Battery AD–X2, manufactured by Pioneers, Inc., of Oakland, Calif.

Since making the above statements I have changed my operations from majoring in the battery business to majoring in the tire business. Therefore, I no longer use Battery AD–X2 in the quantities previously shown, although I have continued

to use the product. Only this morning I installed a new battery in my personal car and treated it with Battery AD–X2.

DALLAS BROWN,
Owner, Auto Battery & Tire Co.

Subscribed and sworn to before me this 15th day of April 1953.

W. H. MARKHAM,
Notary Public.

My commission expires June 4, 1966.

SEPTEMBER 23, 1949.

Dr. E. U. CONDON,
Director, National Bureau of Standards,
Washington 25, D. C.

DEAR SIR: Forthwith are statements regarding Battery Additive AD–X2 based on my observations with batteries used in the emergency service vehicles of the city of Oakland.

Some 2 years ago our department was canvassed by Pioneers, Inc., 2411 Grove Street, Oakland, Calif. Their product Battery AD–X2 was described, its qualities were very attractive. After deliberation as to its use, it was decided to test Battery AD–X2 in a pilot battery. The results of this pilot test were above expectation. Following this test more units were treated with exactly the same results. After observation of these tests it was learned that batteries treated with Battery AD–X2 gave longer service periods, withstood higher charge and discharge rates, required less watering, reduced corrosion at terminals and inhibited the shedding of the active material. This material is now used in the batteries of the fire department vehicles and the police department vehicles.

I am familiar with the National Bureau of Standard's Letter Circular 302, from which one would be led to frown on any additive of any nature. It also appears that there could be no change in battery chemistry. I am convinced such reasoning is very unjust to the product Battery AD–X2 and that progress through chemistry is stepping ahead of the National Bureau of Standards.

My position with the city of Oakland is that of engineer-in-charge of radio division. I have been in this capacity for 16 years. Also, have been engaged in radio work since 1917 with the United States Navy and Commercial Radio Co. where battery management has been a part of the occupation.

I make these statements from practical observance of performance in city-owned vehicles as well as my own pleasure vehicle and at the request of Pioneers, Inc.

I have no interest in Pioneers, Inc., of any nature.

R. B. LOHRY.

Subscribed and sworn to before me this 23d day of September 1949.

HENRY E. WALLACE,
Notary Public.

My commission expires January 2, 1953.

CITY OF OAKLAND, CALIF.,
ELECTRICAL DEPARTMENT,
April 5, 1951.

PIONEERS, INC.,
2411 Grove Street, Oakland 12, Calif.
(Attention: Mr. Jess M. Ritchie.)

GENTLEMEN: Answering your question, in working with Battery AD–X2, how long would the useful life of a battery be extended?

In batteries used in radio police vehicles subjected to hard usage and treated with Battery AD–X2 we have observed that the life expectancy was extended from 12 to 18 months beyond normal even though the batteries were not new at the time of treatment.

Based on our experience with your product over a period of more than 3 years, we have found that if a new battery is treated with Battery AD–X2 and given an equalizing charge prior to installation, it is estimated conservatively that the life expectancy will be extended 2½ times the normal life before failure.

Yours truly,

R. B. LOHRY,
Engineer in Charge, Radio Division.

APRIL 14, 1953.

Hon. EDWARD M. THYE,
Chairman, Senate Select Committee on Small Business,
Senate Office Building, Washington 25, D. C.

MY DEAR SENATOR: The following information is given your committee in order that is may have information pertinent to its work on battery AD–X2, manufactured by Pioneers, Inc.

The above affidavit to Dr. E. U. Condon and the above letter to Pioneers, Inc., were written and signed by me on the dates shown. Based on this experience we have continued to use battery AD–X2.

I have had training in both chemical and electrical engineering and am thoroughly familiar with the sulfation problem in the lead-acid battery, as well as with the basic principles involved in solving the problem. Consequently, I have never been able to understand how anyone could consider that the National Bureau of Standards has been objective in their work on the problem.

I think the work done by your committee to date and the prompt and direct action by the Secretary of Commerce in requesting the resignation of the Director of the National Bureau of Standards is to be applauded.

R. B. LOHRY,
Engineer in Charge, Radio Division.

Subscribed and sworn to before me this 15th day of April 1953.

HENRY E. WALLACE,
Notary Public.

My commission expires June 2, 1957.

SEPTEMBER 21, 1949.

Dr. E. U. CONDON,
Director, National Bureau of Standards,
Washington, D. C.

DEAR SIR: As transportation superintendent for the Permanente Cement Co., Permanente, Calif., I have been asked to make the following factual statements in regard to Battery AD–X2.

Late in 1947 we were approached by Mr. Jess M. Ritchie of Pioneers, Inc., and asked to use a battery compound, manufactured by Pioneers, Inc., 2411 Grove Street, Oakland 12, Calif.

In view of the attitude of our battery supplier and the Letter Circular 302 entitled "Battery Compounds and Solutions" published by the National Bureau of Standards, we were reluctant to try a battery additive. However, this organization is always looking for a better and more economical way to do a job with the result that we did test the product in 20 mechanically sound sulfated batteries which we had attempted to charge from time to time without success.

The 20 batteries were treated with the additive and placed on charge on the same charging equipment that had previously failed to move the batteries. All 20 of the batteries came to full charge.

After this demonstration we established the policy of treating all of our batteries, new stored and those in operation, with the following results: Prior to standardizing on the use of Battery AD–X2 our battery costs from February 1947 to February 1948, were $1,830.77. After a full year's use of Battery AD–X2 our battery costs on the same operation from February 1948 to February 1949 were $936.26, which represents a substantial saving of $894.51. The 7 months' battery costs from February 1949 to date, show a slightly lower rate than the battery costs for 1948.

Our battery supplier still maintains that Battery AD–X2 is of no value. After the above experience with Battery AD–X2 it is my definite opinion that your Circular Letter 302, Battery Compounds and Solutions, does not apply to Pioneers, Inc. Battery AD–X2 and its circulation without excepting this product is unfair to Pioneers, Inc.

R. R. LITTLE.

Subscribed and sworn to before me this 21st day of September, 1949.

HENRY E. WALLACE,
Notary Public.

My commission expires January 2, 1953.

APRIL 15, 1953.

Hon. EDWARD J. THYE,
Chairman, Senate Select Committee on Small Business,
Senate Office Building, Washington 25, D. C.

MY DEAR SENATOR: Since writing the above affidavit to Dr. E. U. Condon in September 1949, we have constantly maintained a stock of Battery AD–X2 for use in our batteries. The material has been consistently satisfactory.

The facts outlined in the above affidavit have, of course, not changed.

R. R. LITTLE,
Transportation Superintendent,
Permanente Cement Co.

Subscribed and sworn to before me this 16th day of April, 1953.

K. D. BABB,
Notary Public.

My commission expires April 19, 1953.

SEPTEMBER 19, 1949.

Dr. E. U. CONDON,
Director, National Bureau of Standards,
Washington 25, D. C.

DEAR SIR: At the present time I am connected with the Western Machinery Co., San Francisco, Calif. Prior to this, I was employed as master mechanic by McGuire & Hester, pipeline contractors of Oakland, Calif., and the Maaco Construction Co., Clearwater, Calif. I have had over 20 years experience in maintenance and repair of construction and highway equipment. During that period of time, I have come in contact with many battery "dopes". I am also familiar with Letter Circular 302 published by your Bureau regarding battery compounds and solutions.

During the month of November 1947 while connected with McGuire & Hester, I was approached by Mr. Jess M. Ritchie of Pioneers, Inc., 2411 Grove Street, Oakland 12, Calif., on the subject of using a battery additive manufactured by his company. In view of the Bureau of Standard's report and my previous experience with battery additives, I was most reluctant to try Battery AD–X2. However, we had some 27 batteries which had sulfated out while standing idle in equipment in the yard and which we had attempted to charge at various times without success. Mr. Ritchie chose 20 of these batteries which were not broken, checked them for cell shorts and put them back on the same charging equipment and under the same conditions which had previously failed to put a charge in the batteries. We then treated them with Pioneers, Inc., additive, Battery AD–X2. When 90 percent of these batteries took a charge, I changed my mind about battery additives, insofar as Pioneer's, Inc., Battery AD–X2 is concerned.

McGuire & Hester operates over 100 pieces of equipment of all types normally used in heavy construction. The equipment is stored in the yard for long periods of time resulting in heavy loss of batteries due to heavy sulfation. In my year and a half experience with Battery AD–X2 I saw replacement costs to McGuire & Hester cut by well over 80 percent. Also, in no case did a battery refuse to take a charge due to sulfation, after we adopted Battery AD–X2 into our operations.

Some 3 months ago, our previous supplier of batteries was still trying to explain to me that the Bureau of Standards condemned all battery additives and that Battery AD–X2 was no good.

It is my opinion, based upon the above facts, that your pamphlet, Battery Compounds and Solutions, is definitely unfair to Pioneers, Inc.

I have no connections with Pioneers, Inc., whatsoever. I have made this statement of my own free will at the request of Pioneers, Inc. Address: 4243 Balfour Street, Oakland, Calif.

LEONARD T. METCALF.

Subscribed and sworn to before me this 19th day of September 1949.

HENRY E. WALLACE,
Notary Public.

My commission expires January 2, 1953.

APRIL 18, 1953.

Hon. EDWARD J. THYE,
Chairman, Senate Select Committee on Small Business,
Senate Office Building, Washington 25, D. C.

MY DEAR SENATOR: Since making the above affidavit in September 1949 I have continued my employment with Edward R. Bacon Co., of San Francisco, which is a part of Western Machinery Co. My major efforts are put forth in the sale of digging teeth for shovels, cranes, ditching machines, etc.

As is obvious, I do not, in my present position, have use for Battery AD–X2 in the quantities outlined above. However, the facts set forth in the above affidavit have not changed. I have used Battery AD–X2 continuously in my own personal equipment since making the above affidavit. I have never had reason to doubt the manufacturer's advertising claims. The use of Battery AD–X2 in my personal batteries over this long period of years has convinced me that if the material is used in mechanically sound sulfated batteries, it will extend their life expectancy. Furthermore, if the material is added to a new mechanically sound battery, I have observed that it will at least double the battery's life expectancy.

I wish your committee every success in continuing to give the truth of the Battery AD–X2 problem to the public and the executive branch of the Government.

LEONARD T. METCALF.

OAKLAND, CALIF.

Subscribed and sworn to before me this 18th day of April 1953.

P. M. EBERHART,
Notary Public.

My commission expires February 5, 1955.

SEPTEMBER 19, 1949.

Mr. E. U. CONDON,
Director, National Bureau of Standards,
Washington 25, D. C.

DEAR SIR: I have been building, repairing, and doing battery-maintenance work for over 10 years. At the request of the manufacturer, I submit the following factual statements on Battery AD–X2 as manufactured by Pioneers, Inc., 2411 Grove Street, Oakland, Calif.

In the application of several hundred treatments of Battery AD–X2 to badly sulfated batteries, I have not seen one instance where Battery AD–X2 has failed to desulfate a battery regardless of the degree of sulfation. I know that many of these batteries were too badly sulfated to take a normal charge. However, as an example I cite one set of batteries, diesel locomotive, 32 cells in all, not less than 4 years old. Several attempts had been made over a 6-month period to bring these batteries to charge. They were finally condemned and sent to the shop where I work. I spot-checked the cells, determined that the batteries were mechanically sound, and treated them with Battery AD–X2. The batteries came to full charge and are now back in the locomotive and giving trouble-free service. The batteries have a value of $700 and the cost of treating them with Battery AD–X2 was under $100.

I am familiar with Circular Letter 302 published by the National Bureau of Standards, and the pamphlet, Battery Compounds and Solutions, put out by the National Better Business Bureau. It is my opinion that these publications are definitely unfair to Pioneers, Inc., and to the public who would benefit by the use of Battery AD–X2.

Although I am employed as battery man at Stockton Annex, Naval Supply Base, Rough and Ready Island, Stockton, Calif., I make these statements as an individual and not as an employee of the Navy.

I am not connected with Pioneers, Inc., in any way. However, I am interested in promoting dissemination of correct information to the public and have therefore made these statements at the request of Pioneers, Inc.

OLIN ROSSELL.

Subscribed and sworn to before me this 20th day of September 1949.

FRED WESTBROOK,
Notary Public.

My commission expires April 8, 1953.

APRIL 9, 1953.

HON. SINCLAIR WEEKS,
Secretary of Commerce,
Department of Commerce, Washington 25, D. C.

DEAR MR. SECRETARY: The above statement to Dr. E. U. Condon on September 19, 1949, is just as true a statement as of this date (April 9, 1953) as when it was made. The Navy at Rough and Ready Island has not purchased Battery AD–X2, to my knowledge, since 1950. In compliance with orders from higher authority, use of the material was discontinued. I have continued to use the material in my own personal equipment and have found that it has more than doubled the life expectancy of my personally owned batteries. The Navy, to the best of my knowledge, has junked thousands of dollars worth of batteries at the supply annex which could have been put into normal service by treatment with the product. Incidentally, we still occasionally find a battery that was treated with the product and recovered from salvage as far back as 1948.

Although I am still employed by the Navy, I make this statement as a citizen and not as an employee of the Navy.

You, sir, are to be congratulated on revoking Letter Circular 504.

Respectfully yours,

OLIN ROSSELL.

Subscribed and sworn to before me this 10th day of April 1953.

MAUDE D. WILSON,
Notary Public.

My commission expires June 10, 1955.

EXHIBIT 16

CORRESPONDENCE BETWEEN NATIONAL BUREAU OF STANDARDS AND THE NATIONAL BETTER BUSINESS BUREAU

JUNE 25, 1948.

MR. K. B. WILLSON,
Operating Manager, National Better Business Bureau, Inc.,
New York 17, N. Y.

DEAR MR. WILLSON: This is in reply to your letter of June 10, 1948, regarding battery compounds which seem to be becoming increasingly numerous and troublesome.

I see no reason at the present time to change the statements made in our Letter Circular 302, but realize that the date of this circular is rather far back. The later statement by Dr. Briggs which you have quoted is, I think, a very good statement, and I see no reason why you should not continue to use it.

Aside from a few tests made recently, the only other work we have done on this subject was in connection with a search for satisfactory methods of storing surplus batteries following the close of the war. Several of the common ingredients in the battery compounds were tried at that time and none of them proved effective. This experiment ran over a period of about 2 years, and the final report has not yet been prepared.

I have had it in mind for some time that we should issue a new letter circular to supersede the present 302, and in the new circular incorporate some of the data more recently obtained. Unfortunately, the press of other matters has prevented me from doing this. I shall be glad to have your opinion as to the desirability of issuing an up-to-date statement of the problem.

Very truly yours,

G. W. VINAL,
Chief, Electrochemistry Section, Division of Electricity and Optics.

NATIONAL BETTER BUSINESS BUREAU, INC.,
New York 17, N. Y., June 30, 1948.

Re: Battery compounds.

Dr. GEORGE VINAL,
National Bureau of Standards,
Washington, D. C.

DEAR DR. VINAL: I think it would be extremely helpful to American business and to governmental agencies if you would issue a new statement on battery dopes.

There are several such products on the market at this time. Perhaps the most aggressive is Protecto-Charge, which is being promoted out of Oakland, Calif. I am taking the liberty of attaching some correspondence from Dr. Merle Randall, who objects to our Battery Dopes bulletin. I note that he also has written to you.

When battery compound vendors can sell their products to governmental agencies and then use that fact to convince others that their product has merit, it would seem an appropriate time to have an official statement with a fresh date from the Government's highest authority on the subject, the National Bureau of Standards.

I do not know Dr. Randall, but he is presumed to have some standing and his vouching for the product lends further support for it in the minds of the inexperienced and the uninformed.

A revised letter circular would help to clear the air and would serve a most useful purpose. If this is not practical at the moment, a basic statement on the subject would do just as well. If we could be helpful by directing a letter of inquiry asking specific questions, we would be glad to prepare it and get it off upon hearing from you.

I would appreciate learning what you believe might be done about the problem. Will you please return the enclosures?

Cordially yours,

K. B. WILLSON,
Operating Manager.

JULY 16, 1948.

Mr. K. B. WILLSON,
Operating Manager, National Better Business Bureau, Inc.,
New York 17, N. Y.

DEAR MR. WILLSON: Your letter of June 30, 1948, with reference to battery compounds was received during my absence from the city, and therefore my reply has been somewhat delayed.

This morning I had the pleasure of talking with your Mr. Burke, who called at my office. I discussed the matter with him in some detail, and he will doubtless give you information which I shall not attempt to put into this letter.

I have had a number of letters from Dr. Merle Randall, with respect to material called Protecto-Charge. In one of his earlier letters he indicated that this material consists of magnesium and sodium sulfates. It would therefore appear to have been of the same general type and class as many other materials with which you are already familiar. While I do not know Dr. Randall personally, I have known of him for many years, that he was a man of standing, and a professor of chemistry at the University of California. I do not know what his present connections may be, but I have been frankly surprised at some of the statements which he has made with respect to the product in which he is interested.

I explained to Mr. Burke this morning that the reason I am not attempting as yet to prepare a new statement on battery compounds to replace the old Letter Circular 302, issued in 1931, is that I have been extremely busy with matters which I regard as important from the standpoint of national defense. I do not feel that I can take too much time to spend on these rather troublesome battery compounds. There seems to be unusual activity at the present time, which is probably the result of shortages of lead and finished batteries.

From the information which I have at present, I do not see how any exception could be made in the matter of Protecto-Charge as requested by Dr. Randall in his letter to you dated June 2.

We have recently completed an experiment, extending over a period of about 2 years, in which batteries were allowed to stand idle for about 1 year, after having been treated in various ways. The object of the experiment was not to study any considerable number of these battery compounds but rather to determine what standard means there might be for preserving storage batteries in the wet condition.

Some of the information gained during the course of this experiment, however, does have a bearing on the problem of battery compounds and may be used in revising Letter Circular 302. I cannot promise now when I shall be able to undertake it, but hope that it will not be too long delayed.

Very truly yours,

G. W. VINAL,
Chief, Electrochemistry Section,
Division of Electricity and Optics.

NATIONAL BETTER BUSINESS BUREAU, INC.,
New York 17, N. Y., July 28, 1948.

Dr. G. W. VINAL,
Chief, Electrochemistry Section, Division of Electricity and Optics,
United States Bureau of Standards, Washington 25, D. C.

DEAR DR. VINAL: Thanks for your letter of July 16.

Mr. Burke has told me of his visit with you and I was very pleased to learn of developments. I sincerely trust that you will find it possible to issue a new statement concerning battery dopes. If the statement is nothing more than a reiteration of Letter Circular 302, with a few added comments, it will be extremely helpful in controlling the current crop.

We do hope that you will be able to spare some time from your more important activities for this chore before too long.

Cordially yours,

K. B. WILLSON,
Operating Manager.

DECEMBER 9, 1948.

Mr. K. B. WILLSON,
National Better Business Bureau, Inc.,
New York 17, N. Y.

DEAR MR. WILLSON: Reference is made to our previous correspondence on the subject of battery dopes and a revision of Letter Circular No. 302. We have made a complete revision of Letter Circular 302 but have not submitted it to our Publications Section since I wanted your comments on the article with reference to subject matter and any possible legal complications.

I am enclosing a rough draft of the revision of Letter Circular 302 on which I would appreciate your comments and criticism at your earliest convenience. I must ask that you refrain from using or making reference to this article until it has been officially released by this Bureau.

At a recent meeting of the Association of American Battery Manufacturers in Chicago I discussed this revision with several present and left a copy with Mr. L. E. Wells for his comments.

Very truly yours,

GEORGE W. VINAL,
Chief, Electrochemistry Section,
Division of Electricity and Optics.

NATIONAL BETTER BUSINESS BUREAU, INC.,
New York 17, N. Y., December 15, 1948.

Re File 1.8.

Dr. GEORGE W. VINAL,
Chief, Electrochemistry Section, Division of Electricity and Optics,
National Bureau of Standards, United States Department of Commerce,
Washington, D. C.

DEAR DR. VINAL: I think the proposed revision of Letter Circular No. 302 is excellent, and its early release will serve a very timely and useful purpose in helping to protect the trade and the public.

I have but two suggestions to make:

Would it be possible for you to add at the very end of your bulletin, on page 5, the statement attributed to Dr. Briggs on the attached National Better Business Bureau bulletin, to the effect that although hundreds of proprietary battery compounds have been tested by the National Bureau of Standards, none of those tested have produced any beneficial effect when added to the regular electrolyte?

Would it also be possible for you to add a general statement for the benefit of lay readers to the effect that there is no short cut to battery health, or substitute for proper care? Perhaps this statement is not too important, but we believe it would help to educate the uninformed battery owner.

We will be very glad to give the letter circular widespread publicity when it is released, and I would appreciate it if you would let me have an advance copy a week or so before you release it so that we can get our material ready to send out on or after your release date. All of the better business bureaus and chambers of commerce will be very much interested in getting a copy of this material as soon as possible, and we will be glad to see that they get it.

Cordially yours,

K. B. WILLSON,
Operating Manager.

DECEMBER 22, 1948.

Subject: AD–X2 (Protecto-Charge).

Mr. JACK A. HARRIS,
General Manager, Better Business Bureau,
Oakland 4, Calif.

DEAR MR. HARRIS: I received your letter of December 1 with reference to a product called AD–X2 (Protecto-Charge). During the past 25 years several hundred materials alleged to improve the performance of storage batteries have appeared. Some of these have been tested at this Bureau. Many of these materials have contained magnesium sulfate and sodium sulfate. These substances with the required amount of water of hydration are commonly known as epsom salt and glauber salt. These materials have not been found beneficial in the operation of storage batteries and we so reported in our Letter Circular No. 302 which has been widely distributed.

This Bureau has not made any tests of AD–X2 (Protecto-Charge), the main reason being that Dr. Merle Randall who is connected with the company informed us by letter on April 23, 1948, that Protecto-Charge involves the addition of a mixture of anhydrous sodium sulfate and a slightly basic, nearly anhydrous magnesium sulfate to the water when it is filled with the standard sulfuric acid electrolyte. Epsom salt and glauber salt differ from these substances only in having water of crystallization. When the dry salts are added to a water solution the result is essentially the same as if proportionately larger amounts of glauber salt and epsom salt had been added. In the anhydrous state they are not called epsom salt and glauber salt, but this is merely a matter of terminology.

We have been informed that tests of this material are being made at the Signal Corps Laboratory at Fort Monmouth, N. J., and at the New York and Mare Island Navy Yards. These are competent laboratories dealing with large numbers of batteries. In view of the above fact it does not seem desirable for a fourth Government agency—that is, this Bureau—to spend the time urgently needed for Army and Navy work to make further tests of these materials.

This Bureau does not make commercial tests of batteries or battery materials and it is an established policy of the Bureau not to endorse commercial products or to permit the results of its tests to be used for advertising purposes.

We have recently had some correspondence with the National Better Business Bureau in New York on the subject of revising and making more emphatic Letter Circular No. 302 which this Bureau issued some years ago regarding materials said to improve the performance of batteries. You may wish to contact the National Better Business Bureau in this connection at its headquarters in New York.

We are retaining the samples which you sent for further reference, if necessary.

Very truly yours,

GEORGE W. VINAL,
Chief, Electrochemical Section,
Division of Electricity and Optics.

DECEMBER 22, 1948.

Mr. K. B. WILLSON,
National Better Business Bureau, Inc.,
Chrysler Building, New York 17, N. Y.

DEAR MR. WILLSON: I thank you for your letter of December 15 with reference to the proposed revision of our Letter Circular No. 302 on battery compounds and solutions. It will be entirely possible to make the few changes that you have

suggested. Before this letter circular can be issued it will be necessary for it to be formally approved by the Bureau editorial committee and released by the Director. I think that can be done without much delay.

In my previous letter I asked whether you could see any statements which might involve legal complications. I presume from the fact that you have not mentioned it in your reply you found the statements satisfactory in this respect.

Very truly yours,

GEORGE W. VINAL,
Chief, Electrochemistry Section,
Division of Electricity and Optics.

NATIONAL BETTER BUSINESS BUREAU, INC.,
New York 17, N. Y., February 11, 1949.

Dr. GEORGE W. VINAL,
Chief, Electrochemistry Section,
Division of Electricity and Optics,
United States Department of Commerce,
National Bureau of Standards, Washington 25, D. C.

DEAR DR. VINAL: Are you in a position as yet to let us know when the new Letter Circular 302 on "battery dopes" will be available for release?

Cordially yours,

K. B. WILLSON,
Operating Manager.

FEBRUARY 23, 1949.

Mr. K. B. WILLSON,
National Better Business Bureau, Inc.,
Chrysler Building, New York 17, N. Y.

DEAR MR. WILLSON: Replying to your letter of February 11, the proposed revision of Letter Circular No. 302 on (battery dopes) has not been issued because it is the opinion of some members of the Bureau staff that a more formal and informative publication of this subject should be prepared. In the meantime we are having copies of Letter Circular 302 remimeographed and some of these can be sent to you, if you desire them.

There are several matters in connection with this subject of comparatively recent origin which I would like to discuss with you informally. I am expecting to be in New York in the next week or two and would be glad to call at your office, if that is convenient to you. I cannot say now exactly what day I shall be in New York.

Very truly yours,

GEORGE W. VINAL,
Chief, Electrochemistry Section,
Division of Electricity and Optics.

NATIONAL BETTER BUSINESS BUREAU, INC.,
New York 17, N. Y., February 28, 1949

Dr. GEORGE W. VINAL,
Chief, Electrochemistry Section, Division of Electricity and Optics,
United States Department of Commerce,
National Bureau of Standards, Washington 25, D. C.

DEAR DR. VINAL: The persistent promotion of battery compounds to the public for use as additives to the battery electrolyte pose a serious problem, and we respectfully ask whether it will not be possible for the National Bureau of Standards to give us an official up-to-date statement which we may use for the information and guidance of the public.

The statement which Dr. Briggs gave us a few years ago, which is reproduced in the attached leaflet, was eminently satisfactory. We would like a similar one with a current date for publication in a new leaflet on the subject.

If this is possible, I wish that in the course of the statement you would please provide answers to the following questions:

1. Over how long a period of time has the National Bureau of Standards investigated additives for battery compounds and approximately how many have been brought to your attention?
2. What did you analyses of the materials show as to their composition?

3. What are the principal claims made for these products?
4. What are your findings as to the performance possibilities of these products?
5. Does the National Bureau of Standards recommend the addition of any additive to the standard battery electrolyte?
6. What is your conclusion as to whether battery additives serve a useful purpose?

Performing a public service with the support of private industry, we are delighted to learn that Letter Circular 302 will be revised and are confident that it will be of great value to the public. In the meantime, I hope you can give us a summary statement on the subject so as to enable us to serve the immediate and pressing need.

Cordially yours,

K. B. WILLSON,
Operating Manager.

MARCH 9, 1949.

Subject: Battery compounds and solutions.

Mr. K. B. WILLSON,
National Better Business Bureau, Inc.,
Chrysler Building, New York 17, N. Y.

DEAR MR. WILLSON: This is in reply to your letter of February 28, addressed to Dr. Vinal, about battery compounds and solutions. It is noted that you have asked for an "official up-to-date statement" which you may use for information and guidance of the public. Enclosed herewith is such a statement which is a revision of the earlier statement forwarded to you by Dr. Lyman J. Briggs, then Director of this Bureau. I trust the enclosed statement may meet your needs.

Very truly yours,

E. U. CONDON, *Director.*

NATIONAL BETTER BUSINESS BUREAU, INC.,
New York 17, N. Y., March 17, 1949.

Dr. GEORGE W. VINAL,
Chief, Electrochemistry Section,
Division of Electricity and Optics,
National Bureau of Standards,
U. S. Department of Commerce,
Washington 25, D. C.

DEAR DR. VINAL: Many thanks for the splendid statement that you obtained for us from Condon. I attach our mimeographed version of it. It will be printed in leaflet form shortly.

A question has been raised in our minds, however, as to whether the following sentence in the fourth paragraph of the statement is entirely correct. The sentence reads as follows:

"The battery is then rested for a few minutes, turn the switch 'on' and step on starter."

Will you please verify this sentence, or wire us a correction?

* * * * * * *

The Bureau of Ships has told me that it cannot release the results of its tests on AD–X2 without the consent of the company involved. Can you tell me whether the results were negative?

The Detroit Arsenal reported as follows on its tests:

"In reply to your letter dated February 25, 1949, reference Protecto-Charge, tests conducted by this office have demonstrated that a battery that has failed through normal use cannot be rejuvenated by the use of this material so that any definite or dependable results can be obtained.

"As far as new batteries are concerned, tests have also demonstrated that good preventative maintenance will produce about the same results as claimed for this material"

Many thanks for your splendid cooperation in this matter.

Cordially yours,

K. B. WILLSON,
Operating Manager.

MARCH 21, 1949.

Mr. K. B. WILLSON,
National Better Business Bureau, Inc.,
Chrysler Building, New York 17, N. Y.

DEAR MR. WILLSON: I have received your letter of March 17 and am glad that you are pleased with the statement which was sent to you over the signature of Dr. Condon.

With reference to the sentence which reads, "The battery is then rested for a few minutes, turn the switch 'on' and step on starter," we believe that this sentence represents several statements made in advertising literature. It is not a direct quotation. We particularly have avoided doing so.

As an indication of the basis for the above statement the following appears in Ever Start literature, "In case of accidentally leaving switch, radio, or lights on, turn off switch and let battery rest a few minutes. It will start your car."

A leaflet on "Sure Start" contains the following paragraph:

"During the annual Southwestern Exposition and Fat Stock Show held at Fort Worth, Tex., in March 1940, the same battery at the Sure Start both was run-down 161 times with an average of 20 minutes generation between each breakdown demonstration. *After each breakdown the battery was powerful enough after our regular 3-minute wait to start the motor in the usual manner.* This battery was 18 months' old at the time of the demonstration and is still in service."

We have italicized one sentence as being the part particularly applicable in the present case.

A third example is taken from a leaflet about Ever-Charge. "In case of accidental leaving switch, radio, or lights on, turn off switch and let battery rest a few minutes. It will start your car."

I do not have a report of the experiments made by the Bureau of Ships on AD–X2 and do not know whether a report has actually been issued. I understand that they did not find this material of advantage but that is, of course, entirely unofficial.

The statements made by the Detroit Arsenal which you quoted would seem to be directly contrary to test reports of Benecia Arsenal and Aberdeen. It is my belief that the statement by the Detroit Arsenal is more authoritative than the others.

In the advertising literature for AD–X2 you will note on the first page the heading "Aging of Lead Sulfate." It is noted that Dr. Randall has a paper entitled "Aging of Lead Sulfate in Lead-Acid Storage Batteries" scheduled for presentation at the meeting of the American Chemical Society in San Francisco, Wednesday, March 30, at the Division of Analytical and Microchemistry.

Very truly yours,

GEORGE W. VINAL,
Chief, Electrochemistry Section,
Division of Electricity and Optics.

NATIONAL BETTER BUSINESS BUREAU, INC.,
New York 17, N. Y., June 7, 1949.

Re AD–X2 (Protecto-Charge).

Dr. GEORGE W. VINAL,
Chief, Electrochemistry Section,
Division of Electricity and Optics,
National Bureau of Standards,
United States Department of Commerce,
Washington 25, D. C.

DEAR DR. VINAL: The Detroit Arsenal recently sent us a copy of the report of the Aberdeen Proving Ground, and also a copy of the report of the New York Naval Shipyard on Protecto-Charge. I wonder if you have seen these and, if so, what you make of them?

The Aberdeen report seems quite favorable to me, insofar as mechanically sound batteries are concerned, but the New York Naval Shipyard report, which seems to be the more comprehensive one, appears to be definitely unfavorable.

If you are familiar with these reports, I would very much appreciate having the benefit of your evaluation of them.

I also would appreciate learning whether you are making tests on Protecto-Charge and, if so, when you expect they will be completed. As you know, this

advertiser is most insistent that his product is unlike all other battery additives and that it will do what he claims for it. Under the circumstances, we are most anxious to obtain conclusive information concerning it, and will appreciate your continued assistance.

Cordially yours.

K. B. WILLSON,
Operating Manager.

JUNE 10, 1949.

Subject: AD–X2 (Protecto-Charge).

Mr. K. B. WILLSON,
National Better Business Bureau, Inc.,
Chrysler Building, New York 17, N. Y.

DEAR MR. WILLSON: Reference is made to your letter of June 7, 1949, regarding Aberdeen Proving Ground and New York Naval Shipyard reports on Protecto-Charge or AD–X2.

In my opinion the New York Navy Yard report is a comprehensive and thorough test for such material. In order to overcome the persistent and exaggerated claims made by exponents of the battery rejuvenators the public must be educated in the art of comparison. It is a well-known fact that comparison is uppermost in the general competitive sales picture of standard items.

If you review the past advertising and demonstration procedures for battery "dopes" you will find their claims are essentially the same. In all cases they direct that the battery be treated and then charged before demonstrating that it has some immediate capacity. The same procedure has been followed with Protecto-Charge at the Aberdeen demonstration.

In the Aberdeen report you will note that a demonstration was given by the representatives of Pioneer, Inc. The statement as to the batteries being ready for salvage is not borne out by the reasons given since no effort was made to fill the cells with water and recharge over an extended period to determine what the actual condition was. The statement that "no voltage or amperage registered" has no significance since this is true of any battery which has dried out. Statement 3 is trite and widely used when discarding batteries. It is questionable how statement 4 could be made since there is no indication that these batteries were taken apart and inspected. This is also true of the next sentence which states that due to preceding reasons the battery is out of service due to sulphation.

In normal military operation batteries are discarded after they reach 80 percent of capacity. Thus it is highly possible that a number of batteries picked from so-called salvage will show some performance. In the case of the 2H battery the specifications call for 50-percent capacity at the 40-ampere rate (2.5-hour rate). In no case have they indicated any tests on untreated batteries to see what they will do. This is very carefully covered in the navy yard report where both treated and untreated batteries were given the same test.

There is one point which should be made clear about the emphasis they put on "comeback" of a storage battery. When a battery is discharged at a high rate such as the Aberdeen tests the acid in the pores of the plate is depleted rapidly. This factor is the major limitation as to the high rate discharge capacity. If this battery is allowed to rest for a short period (2 to 5 minutes) the discharge may be repeated for a substantial part of the previous discharge. This rest period allows the acid to diffuse into the pores again so more capacity may be obtained. This may be repeated a number of times, each one becoming successively shorter in capacity.

Another loose part of the Aberdeen report is in statements made regarding the claims. There is no supporting evidence of sufficient tests or judgment by personnel having fundamental knowledge of batteries.

Claim 3 is definitely not true because if this were the case the plates would be increasing in sulfation to overcome the addition of a 15-point increase in gravity for an ordinary SLI battery when the equivalent amount of sulfate ion such as present in AD–X2 is added.

Claim 6 is due to explanation in an earlier paragraph above.

Claims 9 and 10 hinge on the discarding of Army batteries after their capacity has dropped to 80 percent of initial capacity.

The claim has been made that this is different from all the other "dopes"; however, analysis shows this is practically the same composition as (1) Hi-Charge using partially hydrated sodium and magnesium sulfate, (2) Life Charge, (3) Everstart, (4) Evercharge, all containing the same salts in varying proportions in a partially hydrated condition.

A great many tests have been carried out by various laboratories to determine a means of removing sulfate from plates. None of the tests have shown that either magnesium sulfate or sodium sulfate or their combination as anhydrous or hydrated salts has been the answer. It is up to Randall to prove that his sodium and magnesium sulfate can behave any differently than other. As yet we have seen nothing which indicates this.

I am enclosing a copy of one of our extensive studies on airplane batteries which is for your information only. Here you will find a story essentially the same as that obtained from the navy yard.

If there are further questions I shall be glad to assist you in any way possible.

Very truly yours,

GEORGE W. VINAL,
Chief, Electrochemistry Section,
Division of Electricity and Optics.

JUNE 22, 1949.

Mr. K. B. WILLSON,
National Better Business Bureau, Inc.,
Chrysler Building, New York 17, N. Y.

DEAR MR. WILLSON: Reference is made to your letter of June 17, regarding AD–X2. It has been our policy not to make any tests on commercial products until requested to do so by some Government agency which is interested in the merits of the product. If this matter is turned over to FTC it is possible we may be requested to make tests.

As you know we are making general tests on the various ingredients used in battery "dopes," results of which are to be issued as a research paper.

Very truly yours,

GEORGE W. VINAL,
Chief, Electrochemistry Section,
Division of Electricity and Optics.

OAKLAND CHAMBER OF COMMERCE,
Oakland 12, Calif., August 25, 1949.

Mr. EDWARD L. GREENE,
General Manager, National Better Business Bureau, Inc.,
Chrysler Building, New York 17, N. Y.

DEAR SIR: We are writing you concerning your pamphlet Battery Compounds and Solutions which is working a definite hardship on one of our member firms, Pioneers, Inc. As this is contrary to the aims and purposes of your organization, we feel certain that you will wish to take the necessary steps to alleviate the situation when you become aware of the facts of the case.

We realize that for the protection of the public, your pamphlet Battery Compounds and Solutions has a definite place and were it not for the pamphlet there would be more victims than already exist of the battery "dope" racket. However, Pioneers, Inc., should, in our opinion, be definitely excepted as regards such a publication. With all due respect to the National Bureau of Standards, whom you quote in your pamphlet, we feel that they have not been exactly cooperative regarding the product Battery AD–X2, manufactured by Pioneers, Inc.

In answer to a local businessman's inquiry about Battery AD–X2, Dr. Vinal of the Bureau of Standafds states in a letter dated February 15, 1949: We can give you no definite information in regard to the specific material about which you inquired. This Bureau does not endorse any of those compounds and we believe the matter was fully explained in our Letter Circular No. 302 to which you referred. Although this was issued some years ago we believe that the statements which it contains are valid today." We assume this statement represents the Bureau of Standards' attitude toward Battery AD–X2 as they have been requested several times to test the product, which they refuse to do.

This organization investigated Pioneers, Inc., prior to their becoming members of the chamber of commerce some 2 years ago. The officers of the corporation enjoy such a reputation in this community that they undoubtedly would not sponsor a dubious product or venture. In this connection, we particularly direct your attention to the fact that Dr. Merle Randall is vice president of Pioneers, Inc. Dr. Randall is a nationally known chemist and an outstanding authority on lead-acid batteries. Further details as to his activities can be found in Who's Who in America and American Men of Science.

The president of Pioneers, Inc., Mr. Jess M. Ritchie, holds a general contractors' class A license in the State of California, which is an outstanding tribute to his ability in the construction field. He has been general superintendent on some of our largest western projects and enjoys the confidence and respect of many of the outstanding construction companies in this community.

Pioneers, Inc., do their advertising only in leading technical journals. Also, we have been advised that they have been thoroughly investigated by the Chemical Engineering Society as well as other leading technical publications and that the results of these investigations have led these publications to print articles favorable to the product Battery AD–X2.

We are enclosing a brochure which Pioneers, Inc., used in their advertising. We request you bear in mind that with few exceptions these letters are signed by principals of the companies attesting to their experience with Battery AD–X2; also, that most of these principals are engineers. The statements contained in these letters and the statements contained in your publication, Battery Compounds and Solutions, are at variance. This variance, as we previously mentioned, is working a hardship on Pioneers, Inc., and is unjust.

It is not the policy of the Oakland Chamber of Commerce to endorse products, but it is our understanding that Pioneers, Inc., have treated thousands of batteries over a period of the past 2 years and has not 1 dissatisfied customer. Nor has one dissatisfied customer beeen reported to the Better Business Bureau of Los Angeles, the Better Business Bureau of San Francisco, Ltd., the Better Business Bureau of Reno, Nev., or the Better Business Bureau of Oakland, Calif. Therefore, we wholeheartedly request in the interest of justice, that your organization give proper publicity to the fact that Pioneers, Inc., are not to be confused with the people or the products outlined in your pamphlet, Battery Compounds and Solutions.

Respectfully yours,

KEN MOELLER,
Manager, Manufacturers Division.

NATIONAL BETTER BUSINESS BUREAU, INC.,
New York 17, N. Y., February 2, 1950.

DR. GEORGE W. VINAL,
Chief, Electrochemistry Section, Division of Electricity and Optics,
United States Department of Commerce,
National Bureau of Standards, Washington 25, D. C.

DEAR DR. VINAL: I very much appreciated the opportunity to discuss with you personally the status of your most recent inquiries into the use of various mixtures of magnesium and sodium sulfate.

It would be greatly appreciated by the National Better Business Bureau if you would be kind enough to send us a copy of your reports and findings in your latest study so that we may be in a position to advise inquirers authoritatively on this vexing subject.

With kindest regards.

Cordially yours,

K. B. WILLSON,
Operating Manager.

NEW YORK, N. Y., *March 3, 1950.*

DR. GEORGE W. VINAL:

I am very anxious to receive a copy of the report on your recent test of sodium and magnesium sulfate and would appreciate any courtesy you can extend to us in this matter.

KENNETH B. WILLSON,
National Better Business Bureau, Inc.

MARCH 6, 1950.

MR. K. B. WILLSON,
National Better Business Bureau, Inc.,
Chrysler Building, New York 17, N. Y.

Retel March 3, will send preliminary draft for comments, March 7.

GEORGE W. VINAL,
National Bureau of Standards.

MARCH 7, 1950.

Mr. K. B. WILLSON,
National Better Business Bureau, Inc.,
Chrysler Building, New York 17, N. Y.

DEAR MR. WILLSON: In response to your telegram of March 3 which I did not receive until March 6, and my reply of the latter date, I am sending herewith rough draft of the proposed circular on battery additives. I had hoped to have it in somewhat better shape before sending it to you. I shall be glad to have your comments and criticisms of both the scientific information and its legal aspects as you have learned from past experience.

Very truly yours,

GEORGE W. VINAL,
Chief, Electrochemistry Section,
Division of Electricity and Optics.

NATIONAL BETTER BUSINESS BUREAU, INC.,
New York 17, N. Y., March 9, 1950.

Re your file 1.8.

Dr. GEORGE W. VINAL,
Chief, Electrochemistry Section, Division of Electricity and Optics,
United States Department of Commerce, National Bureau of Standards,
Washington 25, D. C.

DEAR DR. VINAL: We were very pleased to review the rough draft of the proposed circular on battery additives. We think it is excellent as it is. In view of the scientific test data which you have in support of the bulletin and particularly in view of the corroboration which you have from field tests referred to, I see no reason whatever to have any qualms regarding the legal aspects.

Can you give me any estimate as to when you believe this will be published? Naturally we hope that it will be at a very early date.

In the meantime, in view of the increasing number of inquiries which we, together with other bureaus and battery manufacturers are receiving (some of them undoubtedly planted), we feel obliged to issue a statement. I attach a draft of what we propose to say.

I would like to insert as the next-to-last paragraph on page 2 something to the following effect, if you do not object:

"We also understand that the National Bureau of Standards has in preparation a new letter circular on the subject of battery additives which will discuss the subject in a comprehensive manner from the standpoint of both laboratory and field-test results. No date of publication has been announced, but we anticipate that this letter circular probably will be released within a few months."

I would appreciate hearing from you in regard to this as soon as possible.

Cordially yours,

K. B. WILLSON,
Operating Manager.

MARCH 17, 1950.

Mr. K. B. WILLSON,
National Better Business Bureau, Inc.,
Chrysler Building, New York, N. Y.

DEAR MR. WILLSON: This is to acknowledge your letter of March 9, enclosing a proposed statement addressed to battery manufacturers in regard to a material called AD–X2. We have read this statement carefully and are somewhat surprised at the last paragraph which would seem to indicate that the attitude of the Better Business Bureau with regard to this particular material has changed. If this indicates any pitfalls we would be glad to know more about them. As you will see by the draft of our proposed circular which was sent to you under date of March 7, our experiments indicate that this material is not effective.

Regarding your proposal to insert a reference to the bureau's work, as given in the last paragraph of your letter, we would make the following comments. The new bureau publication will probably be issued as a bureau circular and not as a letter circular. Letter circulars are the mimeographed type with which you are already familiar but this would be a printed circular. The word "letter" should, therefore, be omitted. In the third line of this paragraph the word "subject" should be more clearly defined. In a circular under the title "Battery AD–X2"

it might be concluded that the bureau's circular was relative to that particular substance. This, of course, is not the case as we have investigated others and have not named any of the battery additives. Would you agree to change this sentence to read as follows: "We also understand that the National Bureau of Standards has in preparation a new circular on battery additives which gives a comprehensive summary of both laboratory and field tests." The remaining sentence that you have proposed is satisfactory.

Very truly yours,

GEORGE W. VINAL,
Chief, Electrochemistry Section,
Division of Electricity and Optics.

NATIONAL BETTER BUSINESS BUREAU, INC.,
New York, N. Y., March 29, 1950.

Re your file 1.8/1102c.
Re AD–X2.

Dr. GEORGE W. VINAL,
Chief, Electrochemistry Section, Division of Electricity and Optics,
United States Department of Commerce,
National Bureau of Standards, Washington, D. C.

DEAR DR. VINAL: Many thanks for your letter of March 17.

The reason why we have considered sending a bulletin to battery manufacturers on this subject is because Pioneers, Inc., apparently has been pursuing a deliberate course of making inquiry of various manufacturers and their dealers in regard to the product—AD–X2. When they receive in reply a copy of our bulletin on battery compounds and solutions, they believe they have evidence to show that through the distribution of our bulletin we and the manufacturers distributing it are damaging their business. I do not know what they intend to do with this "evidence," but in view of certain threats which they have made about possible action against the manufacturers, we felt dutybound to put them on notice.

However, Dr. Vinal, there would be no need for us to issue any statement to battery manufacturers, or to anyone else, on this subject if you would permit us to inform Pioneers, Inc., that you have now concluded a comprehensive test of AD–X2, and that you found that AD–X2 is not effective and therefore does not serve a useful purpose when added to storage batteries.

Pioneers, Inc., has always been in the position to tell us that although they agree completely with everything that Dr. Condon stated in our bulletin, the National Bureau of Standards has not tested their product and, therefore, was not in a position to state with authority that it is not the exception that they claim it to be. If we now can tell Pioneers, Inc., that you have tested their product and found it wanting, they may continue to dispute your findings and conclusions but they cannot claim that they are based upon theory and not an intimate knowledge of the product.

I would very much appreciate hearing from you as soon as possible as to whether we may be free to reveal that you have tested their product and that you find that it is not effective.

Cordially yours,

K. B. WILLSON,
Operating Manager.

APRIL 5, 1950.

Mr. K. B. WILLSON,
National Better Business Bureau, Inc.,
Chrysler Building, New York, N. Y.

DEAR MR. WILLSON: This is to acknowledge your letter of March 29 with reference to a battery additive known as AD–X2. After talking the matter over with administrative officials and several of our technical staff, I think it appropriate for you to transmit the following statement to Pioneers, Inc., if you wish to do so.

"At your request for information relative to this bureau's work on battery additives and on one known as AD–X2 in particular, it may be stated that the bureau, for its own information, has made extended experiments recently, the results of which confirm our previous conclusions that magnesium sulfate and sodium sulfate are not effective as alleged in restoring storage batteries or in prolonging their life. On the basis of these recent experiments we have no reason to modify statements previously made in our Letter Circular 302.

"These experiments were initiated to obtain data on several battery additives at present being sold to the public as well as on a wide range of compositions which the bureau prepared. AD–X2 was therefore included in these tests. The samples of AD–X2 used in these tests were received from the Better Business Bureau of Oakland, Calif. In the preparation of the report the battery additives actually used are designated in code. The bureau was fortunate in procuring a group of batteries in sound mechanical condition but sulfated as a result of long standing. Tests of these extended over 6 months and it is now possible to say that the results show no benefit from the use of these additives, including AD–X2.

NATIONAL BETTER BUSINESS BUREAU, INC.,
New York 17, N. Y., July 19, 1950.

Your file 1.8 1102c

Dr. GEORGE W. VINAL,
Chief, Electrochemistry Section, Division of Electricity and Optics,
National Bureau of Standards,
United States Department of Commerce, Washington 25, D. C.

DEAR DR. VINAL: Since receiving your letter of April 5 concerning AD–X2, we have had some further correspondence with Pioneers, Inc. As a result we have prepared the attached proposed statement to be released along with our bulletin, Battery Compounds and Solutions.

Do you have any objection to our references to the National Bureau of Standards?

Cordially yours,

K. B. WILLSON,
Operating Manager.

JULY 24, 1950.

Mr. K. B. WILLSON,
National Better Business Bureau, Inc.,
Chrysler Building, New York 17, N. Y.

DEAR MR. WILLSON: In reply to your letter of July 19, there is no objection to the use of statements made by this Bureau and cited by you in your letter, concerning the battery additive, AD–X2. It is our understanding that the Bureau's statements concerning AD–X2 will appear only in your bulletin Battery Compounds and Solutions.

Very truly yours,

E. U. CONDON, *Director.*

BATTERY AD–X2

Battery AD–X2 is a battery additive manufactured by Pioneers, Inc., of Oakland, Calif. The product is an anhydrous mixture of sodium sulfate and magnesium sulfate. Pioneers, Inc., has taken the position that although the National Bureau of Standards' findings with respect to sodium sulfate and magnesium sulfate battery "dope," as stated in the attached bulletin Battery Compounds and Solutions are correct as applied to this class of product, they do not apply specifically to Battery AD–X2. Pioneers, Inc., has had voluminous correspondence with both the National Bureau of Standards and the National Better Business Bureau. The National Bureau of Standards has advised NBBB as follows concerning the applicability of its findings to AD–X2:

"At your request for information relative to this Bureau's work on battery additives and on one known as AD–X2 in particular, it may be stated that the Bureau, for its own information has made extended experiments recently, the results of which confirm our previous conclusions that magnesium sulfate and sodium sulfate are not effective as alleged in restoring storage batteries or in prolonging their life. On the basis of these recent experiments we have no reason to modify statements previously made in our letter circular 302.

"These experiments were initiated to obtain data on several battery additives at present being sold to the public as well as on a wide range of compositions which the Bureau prepared. AD–X2 was therefore included in these tests. The samples of AD–X2 used in these tests were received from the Better Business Bureau of Oakland, Calif. In the preparation of the report the battery additives actually used are designated in code. The Bureau was fortunate in procuring a group of batteries in sound mechanical condition but sulfated as a result of long

standing. Tests of these extended over 6 months and it is now possible to say that the results show no benefit from the use of these additives, including AD–X2.

"We have also the results of tests made elsewhere on 200 batteries in actual service on automobiles which were treated with AD–X2. A sufficient number of cells in these batteries were kept in the untreated condition for comparison with the results of these treated. Here again the results show no evidence of beneficial effects of AD–X2. We have been informed also of tests in a university laboratory in which AD–X2 has been tested and reported to have no beneficial effect.

"In view of the tests made here and in competent laboratories elsewhere it is our belief that AD–X2 is not essentially different from other preparations containing magnesium sulfate and sodium sulfate, and that as a class these materials are not beneficial. The results of recent tests are being prepared for issuance as a Bureau circular but in the meantime we see no reason to modify letter circular 302."

Pioneers, Inc., has expressed the view to NBBB that the above quoted findings of the National Bureau of Standards should be discounted for the following reasons:

"In the correspondence between us it has been mentioned many times by both Dr. Randall and ourselves that it is difficult to make a really definitive laboratory test of Battery AD–X2 and that the only practical means of determining the value of the product is through field test.

"As to the field test by the National Bureau of Standards we note that they have definitely stated to you that such a test or tests was made on batteries in actual service. We are well aware of this but as stated to you in previous correspondence these tests were not run in accordance with our specifications and therefore did not indicate the value to be derived from our product."

NATIONAL BETTER BUSINESS BUREAU, INC.

NATIONAL BETTER BUSINESS BUREAU, INC.,
New York, N. Y., October 31, 1950.

Re: Bureau Circular No. 504.

Mr. PAUL L. HOWARD,
Electrochemistry Section, Electricity Division,
United States Department of Commerce,
National Bureau of Standards, Washington, D. C.

DEAR MR. HOWARD: I wish I could give you an accurate estimate of the potential demand for the new circular on battery additives. Much, however, will depend on whether you can permit some complimentary distribution or whether you will have to make a charge for all distribution.

The circular should reach every battery manufacturer, battery dealer, garage, service station, automobile manufacturer, automobile dealer, automotive supply houses, trade papers in the automotive field and all who are concerned directly with the use and servicing of storage batteries in whatever field. Thus the top potential without even considering the lay public would be in the hundreds of thousands. If the circulation will be limited to those who order a copy for a nominal fee, many in the automotive trade will order a copy, but I hesitate to give an estimate. We distributed over 50,000 copies of our most recent publication on the subject entitled "Battery Compounds and Solutions." I should think that you could distribute at least that number of copies of the new letter circular.

If we can be of any help in stimulating circulation of the letter circular, we will be delighted to cooperate. For example, if you could send us a sufficient number of complimentary copies, we would be glad to see that battery manufacturers, automobile manufacturers, automotive publications, all of the better business bureaus and similar firms and organizations which may place quantity orders or which may give publicity to it in their own house organs receive a copy along with our recommendation that it be brought to the attention of their particular audience.

Have you any idea when this will be off the press?

Cordially yours,

K. B. WILLSON,
Operating Manager.

NOVEMBER 16, 1950.

Mr. K. B. WILLSON,
National Better Business Bureau, Inc.,
Chrysler Building, New York, N. Y.

DEAR MR. WILLSON: Thank you for your letter of October 31, regarding Bureau Circular No. 504.

This circular will be similar to other Government publications so a charge will be made for it. It is expected that we will have enough complimentary copies for a small circulation.

Under present conditions we are not sure exactly when the circular will be printed. Present estimates indicate that it will be early in 1951. As soon as I know definitely the date, I will let you know.

Very truly yours,

PAUL L. HOWARD,
Electrochemistry Section,
Electricity Division.

JANUARY 29, 1951.

Mr. K. B. WILLSON,
National Better Business Bureau, Inc.,
Chrysler Building, New York 17, N. Y.

DEAR MR. WILLSON: Circular 504 on battery additives has just been released and is available at the Government Printing Office.

I am enclosing two complimentary copies for your information. I appreciate your suggestions during the preperation of this article and thank you for your cooperation.

Very truly yours,

PAUL L. HOWARD,
Electrochemistry Section,
Electricity Division.

NATIONAL BETTER BUSINESS BUREAU, INC.,
New York 17, N. Y., September 3, 1952.

Dr. A. V. ASTIN,
National Bureau of Standards,
United States Department of Commerce,
Washington 25, D. C.

DEAR DR. ASTIN: Jess M. Ritchie, president of Pioneers, Inc., has made the request of us that we discontinue distribution of the attached bulletin dated August 1950 and entitled "Battery Compounds and Solutions."

Before we make any decision on Mr. Ritchie's request, we would appreciate your courtesy in advising us whether there have been any developments during the past couple of years which would cause the National Bureau of Standards either to withdraw or modify the statement which it furnished to us on the battery additive AD–X2 on April 5, 1950, as quoted in the attached bulletin.

I gather from some of the material sent to me by Mr. Ritchie that there have been some additional tests. If so, would you kindly acquaint us with the results of such tests?

Your courtesy in providing us with the information requested will be sincerely appreciated.

Cordially yours,

KENNETH B. WILLSON,
Executive Vice President.

SEPTEMBER 16, 1952.

Mr. KENNETH B. WILLSON,
Executive Vice President, National Better Busines Bureau, Inc.,
Chrysler Building, New York 17, N. Y.

DEAR MR. WILLSON: I am writing in reply to your letter of September 3, 1952, on the subject of battery additives. There have been no developments which would cause the Bureau to modify its previous statements on battery additives. Circular 504, Battery Additives, summarizes our work in this field. Subsequent investigations have confirmed these results, and I am enclosing a report of some recent work of this kind.

Very truly yours,

A. V. ASTIN, *Director.*

NATIONAL BETTER BUSINESS BUREAU, INC.,
New York 17, N. Y., September 22, 1952.

Mr. A. V. ASTIN,
Director, National Bureau of Standards,
United States Department of Commerce,
Washington 25, D. C.

DEAR MR. ASTIN: Your letter of September 16 is very much appreciated.

In view of the long background in this matter, would you please tell me whether the battery additive referred to in the paper you sent me entitled "Test of a Battery Additive by the National Bureau of Standards" is AD–X2?

Will you also please tell me whether the manufacturer of that battery additive, Pioneers, Inc., has received a copy of this paper?

Your courtesy will be greatly appreciated.

Cordially yours,

KENNETH B. WILLSON,
Executive Vice President.

OCTOBER 2, 1952.

Mr. K. B. WILLSON,
National Better Business Bureau, Inc.,
Chrysler Building, New York 17, N. Y.

DEAR MR. WILLSON: In reply to your letter of September 22, I should like to refer you back to my letter of September 16 and its enclosures—in particular the latter, which summarize the Bureau's position on battery additives. The following comments refer to your specific questions:

Your second question as to whether Pioneers, Inc., has received a copy of our recent report, may be answered in the affirmative. Your first question, however, requires in effect that the Bureau comment on a proprietary product. Our general policy, as you know, is that the Bureau neither approves nor disapproves proprietary products, for product sampling and testing is not a function of the Bureau.

Exceptions to the above policy have been made in a few instances. You are familiar with one in the battery-additive field. Here the reason was the allegation of the manufacturer that his product not only did not fall into that class of materials covered by Circular 504 but that it had not been examined by the Bureau.

At the present time, however, I see no possible need for identification of the battery additive covered in the recent report sent to you, inasmuch as the conclusions of the Bureau with respect to such additives is sufficiently explicit in Circular 504, while more recent studies have served only to confirm the results of prior work.

Very truly yours,

A. V. ASTIN, *Director.*

NATIONAL BETTER BUSINESS BUREAU, INC.,
New York 17, N. Y.

To: Battery manufacturers.
Re Battery AD–X2.

Some time ago you received from us a bulletin entitled "Battery Compounds and Solutions." It consisted almost entirely of a statement on the subject by Dr. E. U. Condon of the National Bureau of Standards.

Pioneers, Inc., manufacturers of a battery additive trademarked under the name "Battery AD–X2," have stated that they concur with Dr. Condon's statements as applied to battery compounds in general. However, they insist that Dr. Condon's statements do not apply to their product and that they have ample scientific test data and field test experience to prove their contentions as well as the fact that Battery AD–X2 functions in accordance with the claims made for it.

In view of the conflict between the stated position of the National Bureau of Standards on the many compounds it has tested and the contention by Pioneers, Inc., that Battery AD–X2 is an exception, the National Better Business Bureau discussed with Pioneers, Inc., the proposition of arranging for an independent test of Battery AD–X2. As Pioneers, Inc., state that the usual life cycle test or modified life cycle test will not prove anything in regard to their product it has been impossible to date to arrange a test satisfactory to all concerned.

Several governmental agencies have tested Battery AD–X2 with negative results but Pioneers, Inc., states that the test procedure used in these cases was a

modified life cycle test and that instructions contained in Pioneers' literature as to the application of the product were not carried out. Consequently Pioneers, Inc., contend that the tests were of no value.

Recently Pioneers, Inc., advised this office that at its request a Government agency was making an on-the-ground investigation of their product and personnel. Presumably a report on the investigation will be available in due course.

The leaflet, Battery Compounds and Solutions, is out of print and will not be reprinted pending clarification of this controversy. In addition you are requested not to circulate the pamphlet pending clarification of the controversy.

MOTOR,
250 West 55th Street, New York 19, N. Y., January 22, 1953.

BUREAU OF STANDARDS,
Washington, D. C.

GENTLEMEN: Recently a good deal has been published about the battery additive known as AD–X2, especially the results of tests conducted by the Massachusetts Institute of Technology. These tests as you know indicated that AD–X2 was helpful in prolonging the life of lead acid storage batteries.

In view of these new findings could you tell us whether you expect to conduct any new tests of this particular battery additive?

We are being asked by our readers which of the several findings they can depend on and this naturally is a tough question for us to answer. We would appreciate it therefore if you could supply us with any further information.

Very truly yours,

EDWARD FORD, *Editor.*

JANUARY 28, 1953.

Mr. EDWARD FORD,
Editor, Motor,
250 West 55th Street, New York 19, N. Y.

DEAR MR. FORD: In response to your letter of January 22, I am enclosing (1) a statement that summarizes the battery additive situation in terms of the Bureau's current knowledge, (2) a copy of the Senate Small Business Committee press release, (3) a copy of a mimeographed report entitled "Study of a Battery Additive" by the National Bureau of Standards, September 5, 1952 (this extensive series of tests was performed upon request of the Senate committee, followed the manufacturer's instructions and was participated in by the manufacturer and his representative· it is this study to which the Senate press release primarily refers), and (4) a copy of Circular 504, Battery Additives.

Very truly yours,

HUGH ODISHAW,
Assistant to the Director.

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